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10MEB306/10AUB306

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018

Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following fluid properties and state their units:
   i) Kinematic viscosity
   ii) Dynamic viscosity
   iii) Surface tension
   iv) Specific gravity
   v) Specific volume **(10 Marks)**

b. A single column U-tube manometer, made of glass tubing having a nominal inside diameter of 2.5 mm, has been used to measure pressure in a pipe or vessel containing air. If the limb opened to atmosphere is 10 percent oversize, find the error in mm of mercury in the measurement of air pressure due to surface tension effects. It is stated that mercury is the manometric fluid for which surface tension $\sigma = 0.514$ N/m and angle of contact $\alpha = 140°$. **(05 Marks)**

c. Calculate the density, specific weight of one litre of petrol of specific gravity = 0.7. **(05 Marks)**

2 a. Differentiate between Absolute and Gauge pressure. **(04 Marks)**

b. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in liquid. **(08 Marks)**

c. A circular opening 3m diameter, in a vertical side of a tank is closed by a disc of 3m diameter which can rotate about a horizontal diameter. Calculate:
   i) The force on the disc and
   ii) The torque required to maintain the disc in equilibrium in the vertical position when the head of water above the horizontal diameter is 4m. **(08 Marks)**

3 a. Explain the terms:
   i) Meta centre
   ii) Meta centric height **(04 Marks)**

b. How will you determine the meta centric height of a floating body experimentally? Explain with neat sketch. **(08 Marks)**

c. A piece of wood (specific gravity = 0.6) of 10 cms square in cross section and 2.5 m long floats in water. How much lead (specific gravity = 12) need to be fastened at the lower end of the stick so that it flows upright with 0.5 m length out of water? **(08 Marks)**

4 a. Derive Bernoulli's equation starting from fundamentals, and state assumptions made. **(10 Marks)**

b. The water is flowing through a taper pipe of length 100 m having diameter 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 liters/second. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. **(10 Marks)**

PART – B

5 a. Derive an expression for the discharge through a venturimeter. **(10 Marks)**

b. A 30 cm × 15 cm venturimeter is provided in a vertical pipeline 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 30 cms. The differential U-tube mercury manometer shows a gauge deflection of 25 cms. Calculate:

i) The discharge of oil.

ii) The pressure difference between the entrance section and throat section.

Take the coefficient of meter as 0.98 and specific gravity of mercury as 13.6. **(10 Marks)**

6 a. Explain the following:

i) Major energy loss

ii) Minor energy loss

iii) Loss of head due to sudden enlargement

iv) Hydraulic gradient line

v) Total energy line **(10 Marks)**

b. For a town water supply, a main pipe line of diameter 0.4 m is required. As pipes more than 0.35 m diameter are not readily available, two parallel pipes of the same diameter were used for water supply. If the total discharge in the parallel pipes is same as in the single main pipe, find the diameter of the parallel pipe. Assume the coefficient of friction is same for all pipes. **(10 Marks)**

7 a. Define the terms:

i) Velocity gradient

ii) Pressure gradient. **(04 Marks)**

b. Derive an expression for the velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe. **(08 Marks)**

c. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe. If 100 kg of the oil is collected in a tank in 30 seconds. Assume laminar flow. **(08 Marks)**

8 a. Define the terms drag and lift. **(04 Marks)**

b. Explain laminar boundary layer and turbulent boundary layer. **(08 Marks)**

c. Air is flowing over a smooth plate with a velocity of 10 m/s. The length of the plate is 1.2 m and the width 0.8 m. If laminar boundary layer exists up to a value of $R_e = 2 \times 10^5$, find the maximum distance from the leading edge upto which laminar boundary layer exists. Find the maximum thickness of laminar boundary layer if the velocity profile is given $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. Take kinematic viscosity for air = 0.15 stokes. **(08 Marks)**

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