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10ME46B/AU46B

Fourth Semester B.E. Degree Examination, Dec.2016/Jan.2017
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 fluid properties:
   i) Density
   ii) Weight density
   iii) Specific volume
   iv) Specific gravity
   v) Surface tension. **(05 Marks)**

b. Explain the phenomenon of capillarity. Obtain an expression for capillarity rise of a liquid. **(08 Marks)**

c. A vertical cylinder of diameter 180mm rotates concentrically inside another cylinder of diameter 181.2mm. Both the cylinders are 300mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of the fluid if a torque of 20Nm is required to rotate the inner cylinder at 120rpm. **(07 Marks)**

2 a. State and prove the Pascal's law. **(10 Marks)**

b. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(10 Marks)**

3 a. Explain the following terms:
   i) Buoyancy
   ii) Centre of Buoyancy
   iii) Meta centre
   iv) Meta centric height. **(04 Marks)**

b. A cylindrical body is 2m in diameter, 2.5m long and weighs 2.2 metric tonnes. The density of sea water is 1025 kg/m^3. Show that the body cannot float with its axis vertical. **(06 Marks)**

c. Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional steady incompressible flow. **(10 Marks)**

4 a. Derive Bernoulli's equation from fundamentals. List all the assumptions made. **(10 Marks)**

b. A non-uniform part of a pipe line 5m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20N/cm^2 and 12.5N/cm^2. If the diameters at the upper and lower ends are 15cm and 10cm respectively. Determine the quantity of water flowing per second. **(10 Marks)**

PART – B

5 a. What is a venturimeter? Derive an expression for discharge through a venturimeter. **(10 Marks)**

b. Using Backingham's π-theorem, show that the velocity through a circular orifice is given by

$$V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right].$$

Where H is the head causing flow, D is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(10 Marks)**

6 a. How will you determine the loss of head due to friction in pipes by using:
i) Darcy formula and ii) Chezy's formula. **(10 Marks)**

b. Three pipes of 400mm, 200mm and 30mm diameters have lengths of 400m, 200m and 300m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe are connected with two tanks whose difference of water levels is 16m. If co-efficient of friction for these pipe is same and equal to 0.005, determine the discharge through the compound pipe neglecting first the minor losses and then including them. **(10 Marks)**

7 a. Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. **(12 Marks)**

b. A fluid of viscosity 0.7 NS/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2. Find:
i) The pressure gradient
ii) The average velocity and
iii) Reynold number of the flow. **(08 Marks)**

8 a. Explain lift and drag. **(06 Marks)**

b. A flat plate 1.5m × 1.5m moves at 50km/hour in a stationary air of density 1.15kg/m^3. If the coefficients of drag and lift are 0.15 and 0.75 respectively, determine:
i) The lift force
ii) The drag force
iii) The resultant force
iv) The power required to keep the plate in motion. **(08 Marks)**

c. Find the velocity of bullet fired in standard air if the mach angle is 30°. Take R = 287.14 J/kg K and K = 1.4 for air. Assume temperature as 15°C. **(06 Marks)**

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