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10ME/AU46B

Fourth Semester B.E. Degree Examination, Dec.2014/Jan.2015

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 properties of fluid:
- | | | |
|-------------------------|---------------------|-----------------------|
| i) Density | ii) Specific volume | iii) Specific gravity |
| iv) Kinematic viscosity | v) Capillarity | |
- b. The pressure outside the droplet of water of diameter 0.04 mm is 10.32 N/cm² (atmospheric pressure). Calculate the pressure within the droplet if surface tension is given as 0.0725 N/m of water. (05 Marks)
- c. Calculate the capillary effect in mm in a glass tube of 4 mm diameter, when immersed in Hg. The temperature of liquid is 20°C and surface tension of Hg at 20°C in contact with air is 0.51 N/m. Angle of contact is 130° (specific gravity of Hg is 13.6). (05 Marks)
- d. Determine the specific gravity of a fluid having viscosity 0.05 poise and kinematic viscosity 0.035 stokes. (05 Marks)
- 2 a. State and prove Pascal's law. (05 Marks)
- b. The right limb of a simple U tube manometer containing Hg is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of pipe is 12 cm below the level of Hg in the right limb. Find the pressure of fluid in the pipe if the difference of Hg level in two limbs is 20 cm. (05 Marks)
- c. A caisson for closing the entrance to a dry dock is of trapezoidal form 16 m wide at the top and 10 m wide at bottom and 6 m 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. (10 Marks)
- 3 a. Define: i) Buoyancy, ii) Centre of buoyancy, iii) Path line, iv) Laminar flow, v) Turbulent flow. (05 Marks)
- b. A body of dimensions 1.5m × 1.0m × 2m weighs 1962 N in water. Find its weight in air. What will be its specific gravity? (05 Marks)
- c. A 25 cm diameter pipe carries oil of specific gravity 0.9 at a velocity of 3 m/s. At another section the diameter is 20 cm. Find the velocity at this section and mass rate of flow of oil. (10 Marks)
- 4 a. What is Euler's equation of motion? How will you obtain Bernoulli's equation from it? (10 Marks)
- b. The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 lt/s. 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/cm². (10 Marks)

PART - B

- 5 a. Sketch and derive the relation for actual discharge through an orifice meter. (10 Marks)
- b. State Buckingham's π theorem. The efficiency η of a fan depends on density ρ , dynamic viscosity μ of the fluid, angular velocity ω , diameter D, discharge Q. Express η in terms of dimensionless parameters. (10 Marks)

- 6 a. Derive the Darcy-Weisbach equation for the loss of head due to friction in a pipe. (10 Marks)
- b. Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m through which water is flowing at a velocity of 3 m/s using: (i) Darcy's formula, (ii) Chezy's formula for which $C = 60$. (10 Marks)
- 7 a. Define Reynolds number. What is its significance? (04 Marks)
- b. Derive Hagen Poissouille's equation for viscous flow through a circular pipe. (10 Marks)
- An oil of viscosity 10 poise flows between two parallel fixed plates which are kept at a distance of 50 mm apart. Find the rate of flow of oil between the plates if the drop of pressure in a length of 1.2 m be 0.3 N/cm^3 . The width of plates is 200 mm. (06 Marks)
- 8 a. Explain terms: i) Lift; ii) Drag; iii) Displacement thickness; iv) Momentum thickness. (08 Marks)
- b. Define the terms subsonic flow and supersonic flow. (04 Marks)
- c. A flat plate $1.5\text{m} \times 1.5\text{m}$ moves at 50 km/hr in stationary air of density 1.15 kg/m^3 . If the coefficient of drag and lift are 0.15 and 0.75 respectively. Determine: (i) lift force; (ii) drag force; (iii) resultant force. (08 Marks)
