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10ME/AU46B

Fourth 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 following and mention their units:
(i) Mass density (ii) Dynamic viscosity (iii) Surface tension
(iv) Bulk modulus (v) Capillarity **(10 Marks)**

b. Explain effect of variation of temperature on viscosity of liquid and gases. **(04 Marks)**

c. A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of 15.10cm. Both cylinders are 25 cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12 N-m is required to rotate the inner cylinder at 100 rpm, determine the viscosity of the fluid. **(06 Marks)**

2 a. Define: (i) Gauge pressure (ii) Vacuum pressure (iii) Absolute pressure. **(03 Marks)**

b. A hydraulic press has a ram of 30 cm diameter and a plunger of 5 cm diameter. Find the weight to be lifted by the hydraulic press. When the force applied at the plunger is 400 N. **(03 Marks)**

c. Derive an expression for total pressure and centre of pressure on an inclined plane surface submerged in liquid. **(08 Marks)**

d. A pipe line which is 4 meter in diameter contains a gate valve. The pressure at the centre of pipe is 19.6 N/cm^2. If the pipe is filled with oil of sp.gr. 0.87, find the force exerted upon the gate and position of centre of pressure. **(06 Marks)**

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

b. Explain the condition for stability of submerged and floating bodies. **(04 Marks)**

c. A cone of specific gravity S, is floating in water with its apex downwards. It has a diameter D and vertical height H. Show that for stable equilibrium of the cone

$$H < \frac{1}{2}\left[\frac{D^2 S^{1/3}}{2 - S^{1/3}}\right]^{1/2}$$ **(12 Marks)**

4 a. Write assumptions made while deriving Euler's equation of motion. **(03 Marks)**

b. Derive Euler's equation of motion. Also derive Bernoulli's equation. **(10 Marks)**

c. A pipe of diameter 400 mm carries water at a velocity of 25 m/sec. The pressures at the points A and B are given as 29.43 N/cm^2 and 22.563 N/cm^2 respectively, while the datum head at A and B are 28 m and 30 m. Find the loss of head between A and B. **(07 Marks)**

PART – B

5 a. Explain: (i) Geometric similarity (ii) Kinematic similarity (iii) Dynamic similarity model and prototype. **(06 Marks)**

b. A vertical venturimeter has an area ratio 5. It has a throat diameter of 10 cm. When oil of specific gravity 0.8 flows through it, the mercury in the differential gauge indicates a difference in height of 12 cm. Find the discharge through venturi. Take $\epsilon_d = 0.98$. **(06 Marks)**

c. The functional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by

$$T = D^5 N^2 \rho \phi \left[\frac{\mu}{D^2 N \rho}\right]$$ **(08 Marks)**

6 a. Derive Darcy Weisbach equation for flow through pipe. **(08 Marks)**

b. What do you mean by hydraulic gradient line and total energy line? **(02 Marks)**

c. A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarges to 300 mm. The height of water level in tank is 8 m above the centre of pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of pipe. **(10 Marks)**

7 a. For a fluid flow through a pipe, show that maximum fluid velocity is twice the average velocity. Also derive Hagen Poiseuille's equation. **(12 Marks)**

b. Determine (i) pressure gradient (ii) the shear stress at the two horizontal parallel plates and (iii) the discharge per meter width for the laminar flow of oil with a maximum velocity of 2 m/sec between two horizontal parallel fixed plates which are 100 mm apart. $\mu = 2.4525$ N-s/m^2. **(08 Marks)**

8 a. Explain the terms:
(i) Lift (ii) Drag (iii) Displacement thickness (iv) Momentum thickness. **(08 Marks)**

b. Define the terms sonic flow, subsonic flow and supersonic flow. **(03 Marks)**

c. A flat plate 1.5m × 1.5m moves at 50 kmph 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) The lift force, (ii) The drag force, (iii) The resultant force, (iv) Power required to the plate in motion. **(09 Marks)**

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