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10ME/AU36B

Third Semester B.E. Degree Examination, January 2013
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following fluid properties. Also mention their units
i) Density ii) Surface tension iii) Viscosity iv) Specific weight. **(08 Marks)**

b. Explain the effect of temperature variation on viscosity of fluids. **(04 Marks)**

c. The dynamic viscosity of an oil used for lubrication between a shaft and a sleeve is 6 poise. The shaft is of diameter 0.4 meter and rotates at 190 rpm. Calculate the power lost in the bearing for the sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. **(08 Marks)**

2 a. State and prove Pascal's law. **(06 Marks)**

b. i) Define absolute pressure
ii) Total pressure
iii) Gauge pressure
iv) Centre of pressure. **(04 Marks)**

c. A simple manometer is used to measure the pressure of oil (sp.gr = 0.8) flowing in a pipe line. Its right limb is open to the atmosphere and left limb is connected to the pipe. The centre of the pipe is 9 cm below the level of mercury (sp.gr = 13.6) in the right limb. If the difference of mercury level in the two limbs is 15 cm. determine the absolute pressure of the oil in N/cm^2. **(04 Marks)**

d. An inclined rectangular sluice gate AB hinged at A of size 1.2 m × 1 m as shown in Fig. Q2(d) is installed to control the discharge of water. Determine the normal force to be applied at B to open the gate. **(06 Marks)**

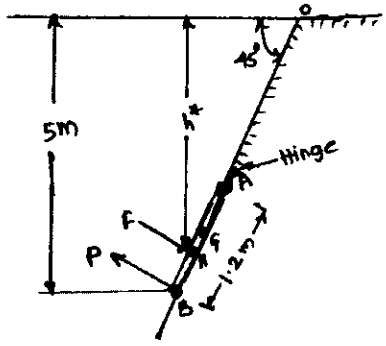

Fig. Q2(d)

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

b. State stability creterian for submerged and floating bodies. **(04 Marks)**

c. A metallic body floats at the interface of mercury of specific gravity 13.6 and water in such a way that 30% of its volume is submerged in mercury and 70% water. Find the density of metallic body. **(04 Marks)**

d. A block of wood of specific gravity 0.8 floats in water. Determine the metacentric height of the block if its size is 3 m long, 2 m wide and 1 m height. State whether equilibrium is stable or unstable. **(08 Marks)**

4 a. Derive Euler's equation of motion for ideal gas and hence deduce Bernaulli's equation of motion state assumptions made. **(10 Marks)**

b. Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom end and upper and respectively. The intensity of pressure at the bottom end is 24.525 N/cm^2 and pressure at the upper end is 9.81 N/cm^2. Determine the difference in the datum head if the rate of flow through pipe is 40 lit/sec. **(10 Marks)**

PART – B

5 a. Derive the expression for discharge through a venture meter. **(04 Marks)**

b. Explain the different type of similitude between model and a prototype. **(06 Marks)**

c. Using Buckingham'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 diameter of orifice, μ - coefficient of viscosity, ρ is the mass density and g is acceleration due to gravity. **(10 Marks)**

6 a. Derive Darcy – Weisbach formula for head loss due to friction in pipe. **(06 Marks)**

b. Define hydraulic gradient and total energy line. **(02 Marks)**

c. A horizontal pipe line 40 m long is connected to a watertank and one end and discharges freely into atmosphere at the other end. For first 25 meter of its length from the tank the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 meter above the centre of the pipe considering all losses of head which occur determine the flow rate. Take f = 0.01 for both sections of pipe. **(12 Marks)**

7 a. Derive an expression for Hegen Poiseuille's formula. **(10 Marks)**

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

8 a. Define terms :

i) Drag
ii) Lift
iii) Displacement thickness
iv) Energy thickness
v) Momentum thickness. **(05 Marks)**

b. Derive an expression for velocity of sound wave in a fluid. **(10 Marks)**

c. Calculate the mach number at a point on a jet propelled aircraft, which is flying at 1100 kmph at sea level where as temperature is 20°C. Take K = 1.4 and R = 287 J/kgK. **(05 Marks)**

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