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10MEB406/10AUB406

Fourth Semester B.E. Degree Examination, June/July 2018
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Assume any missing data suitably.

PART – A

1 a. Differentiate between : (i) Newtonian and non-Newtonian fluids, (ii) Ideal and real fluids, (iii) Dynamic and kinematic viscosity of fluids, (iv) Vapour pressure and cavitation , (v) Mass density and specific weight. **(10 Marks)**

b. Derive an expression for capillary rise in water. **(03 Marks)**

c. An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5 m and it rotates at 200 rpm. Calculate the power lost in oil for a sleeve length of 100 mm. The thickness of oil film is 1.0 mm. **(07 Marks)**

2 a. Define centre of pressure and total pressure. Prove that centre of pressure lies below the centre of gravity of vertically immersed plane surface in a static fluid. **(10 Marks)**

b. A differential monometer is connected at the two points A & B of two pipes as shown in Fig.Q2(b). The pipe A contains a liquid of specific gravity 1.5 while pipe B contains a liquid of specific gravity 0.9. The pressure at A and B are 9.81 N/cm^2 and 17.65 N/cm^2 respectively. Find the difference in mercury level in the differential manometer. **(10 Marks)**

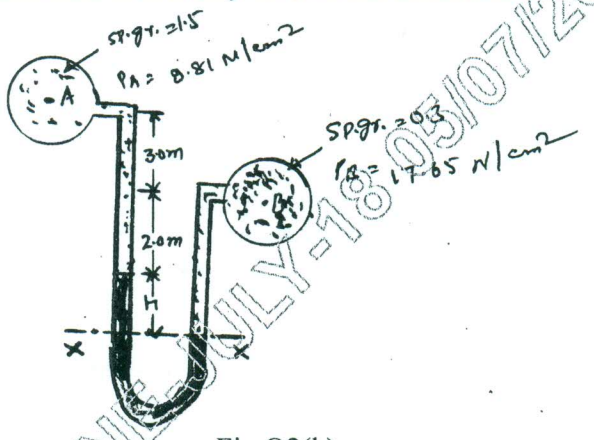

Fig.Q2(b)

3 a. Define the equation of continuity. Obtain the expression for continuity equation for a three dimensional flow. Simplify it to two dimensional steady incompressible flow. **(10 Marks)**

b. A ship 70m long and 10m broad has a displacement of 19620 kN. A weight of 343.35 kN is moved across the deck through a distance of 6m. The ship is tilted through 6°. The moment of inertia of the ship at water-line about its force and aft axis is 75% of M.O.I of the circumscribing rectangle. The centre of buoyancy is 2.25m below water-line. Find the meta-centre height and position of centre of gravity of ship. Specific weight of sea water is 10104 N/m^2. **(10 Marks)**

4 a. State and prove Bernoulli's equation for a fluid flow. Mention assumption made in derivation. **(10 Marks)**

b. The water is flowing through a taper pipe of length 100 m diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 litres/sec. 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. What is venturimeter? Derive an expression for the discharge through a venturimeter. **(08 Marks)**

b. Differentiate between Pitot tube and Orifice meter with neat sketches. **(04 Marks)**

c. The frictional torque T of a disc of diameter D rotating a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5 N^2 \rho \phi \left[\frac{\mu}{D^2 N \rho}\right]$. Prove this by the Buckingham method of dimensions. **(08 Marks)**

6 a. Derive an expression for the head loss due to:
(i) Sudden expansion **(05 Marks)**
(ii) Sudden contraction **(05 Marks)**

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

c. A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. The pressure intensities in the large and smaller pipe is given as 13.734 N/cm^2 and 11.772 N/cm^2 respectively. Find the loss of head due to contraction if $C_d = 0.62$. Also determine the rate of flow of water. **(08 Marks)**

7 a. Sketch the velocity and shear stress distribution across the section of the pipe for viscous flow through it. **(04 Marks)**

b. Derive Hagen – Poiseuille equation with usual notations. **(08 Marks)**

c. A fluid of viscosity 0.7 Ns/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. 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 (iii) Reynold number of the flow **(08 Marks)**

8 a. Define the terms: (i) Boundary layer (ii) Boundary layer thickness (iii) Drag (iv) Lift. **(08 Marks)**

b. Define Mach number. What is the significance of mach number in compressible fluid flows? **(04 Marks)**

c. A flat plate 1.5m × 1.5m moves at 50 km/hr in stationary air of density 1.15 kg/m^2. 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) The power required to keep the plate in motion. **(04 Marks)**

d. A projectile travels in air of pressure 10.1043 N/cm^2 at 10°C at a speed of 1500 km/hr. Find the Mach number and the Mach angle. Take K = 1.4 and R = 287 J/kgK. **(04 Marks)**

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