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10MEB306/10AUB306

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish between the following and mention their units :
i) Specific weight and Mass density ii) Surface tension and Capillarity. **(06 Marks)**

b. Define Compressibility derive an expression for the bulk modulus of elasticity for a perfect gas undergoing the isothermal process. **(06 Marks)**

c. An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5m and it rotates at 200 rpm. Calculate the power lost in oil for a sleeve length of 100mm. The thickness of oil film is 1.0mm. **(08 Marks)**

2 a. Derive an expression for the pressure variation in a static fluid (Hydrostatic law). **(10 Marks)**

b. A cylinder 3m in diameter and 4m long retains water on one side. The cylinder is supported as shown in fig. Q2(b). Determine the horizontal reaction at A and vertical reaction at B. The cylinder weighs 196.2 KN ignore friction. **(10 Marks)**

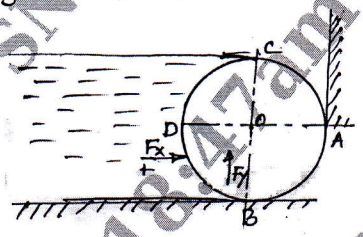

Fig.Q2(b)

3 a. Explain the method to find the metacentric height experimentally. **(08 Marks)**

b. Explain the different types of fluid flows. **(06 Marks)**

c. The velocity components in a two – dimensional flow field for an incompressible fluid are as follows : **(06 Marks)**

$u = \frac{y^3}{3} + 2x - x^2y$ and $v = xy^2 - 2y - \frac{x^3}{3}$. Obtain an expression for stream function ψ.

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

b. The water is flowing through a pipe having diameter 20cm and 10cm at sections 1 and 2 respectively. The rate of flow thorough pipe is 35lit/sec. The section 1 is 6cm above the datum and section 2 is 4m above datum. If the pressure at section 1 is 39.24 N/cm^2, find the intensity of pressure at section 2. **(10 Marks)**

PART – B

5 a. What is a Pitot tube? Derive the formula for measuring the velocity at a point of an incompressible flow using a pitot tube. **(08 Marks)**

b. Using Buckingham's π – theorem, prove that the frictional 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 μ given by

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

c. Define the following dimensionless numbers and mention their significance in fluid flow problems : i) Reynold's number ii) Mach number. (04 Marks)

6 a. Derive Darcy – Weis bach equation for loss of head in pipe due to friction. (10 Marks)
b. Define Hydraulic gradient and Total energy line. (02 Marks)
c. A 150mm diameter pipe reduces in a diameter abruptly to 100mm diameter. If the pipe carries water at 30 litres per second. Calculate the pressure loss across the contraction. Take the co-efficient of contraction as 0.6. (08 Marks)

7 a. Prove the maximum velocity in a circular pipe for a viscous flow is equal to two times the average velocity of the flow. (12 Marks)
b. Crude oil of dynamic viscosity 1.5 poise and specific gravity 0.9 flows through a 20mm diameter vertical pipe. Two pressure gauges have been fixed at 20m apart. The pressure gauge fixed at higher level reads 200 KPa and that lower level reads 600 KPa. Find the direction and rate of flow through the pipe. (08 Marks)

8 a. Derive an expression for displacement thickness and momentum thickness of a flow over a plate. (10 Marks)
b. A man weighing 981 N desends to the ground from an aeroplane with the help of parachute against the resistance of air. The shape of the hemispherical of 2m diameter. Find the velocity of the parachute with which he comes down. Assume $C_d = 0.5$ and density of air as 1.25 kg/m^3. (05 Marks)
c. An aeroplane is flying at an height of 15 km where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg K. Find the speed of the plane. (05 Marks)

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