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337451 (37)

BE (4th Semester)

Examination, Nov-Dec 2021

Branch : Mech.

FLUID MECHANICS (NEW)

Time Allowed : Three Hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Part (a) of each question is compulsory. Solve any two parts from (b), (c) and (d).

Q. 1. (a) What is dynamic viscosity? What are its units. 2

(b) A U-tube differential manometer connecting two pressure pipes at A and B. The pipe A

contains a liquid of specific gravity 1.6 under a pressure of 110 kN/m^2. The pipe B contains oil of specific gravity 0.8 under a pressure of 200 kN/m^2. Find the difference of pressure measured by-mercury as fluid filling U-tube. (Refer to figure 1 given below). 7

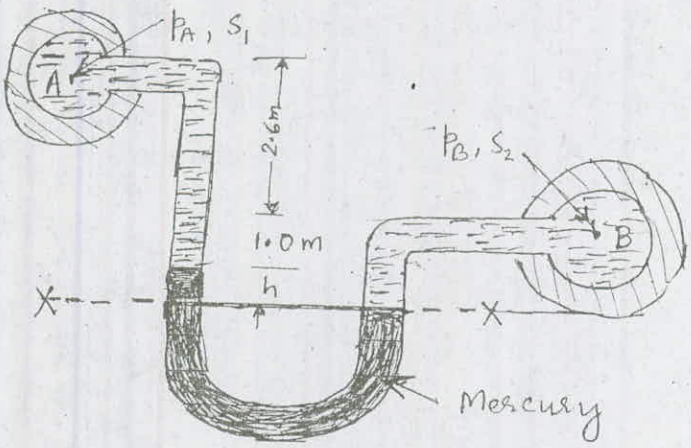

Figure-1

(c) Figure 2 shows a curved surface LM, which is in the form of a quadrant of a circle of radius 3 m, immersed in water. If the width of the gate is unity, calculate the horizontal and vertical components of the total force acting on the curved surface. 7

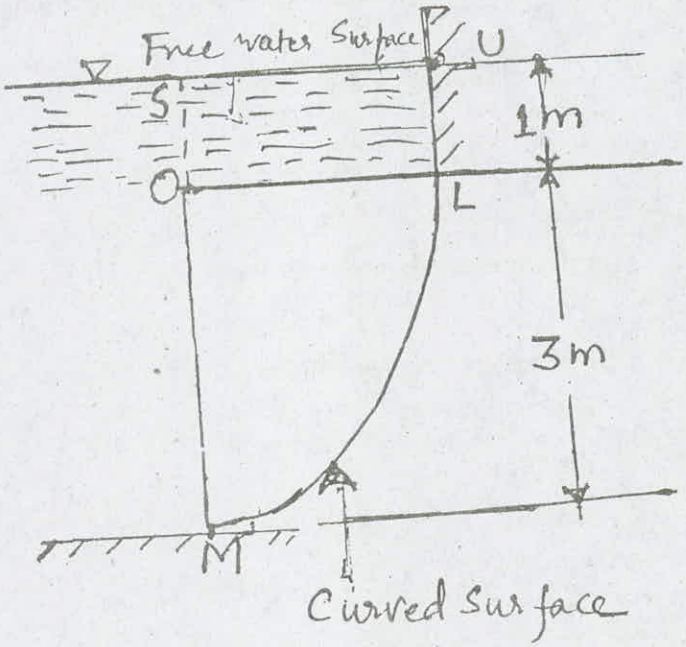

Figure-2

(d) A hollow wooden cylinder of specific gravity 0.6 has an outer diameter of 600 mm and an inner diameter of 300 mm. It is required to float in oil of specific gravity 0.9. Calculate :

(i) the maximum length (height) of the cylinder so that it shall be stable when floating with its axis vertical.

(ii) the depth to which it will sink. 7

Q. 2. (a) Define streak line with example. 2

(b) In an incompressible flow, the velocity vector is given by : 7

$V = (6xt + yz^2)i + (3t + xy^2)j + (xy - 2xyz - 6tz)k$

(i) Verify whether the continuity equation is satisfied.

(ii) Determine the acceleration vector at point L(2, 2, 2) at t = 2.0.

(c) The velocity potential function for a two dimensional flow is $\phi = x(2y - 1)$. At a point P(4, 5) determine : 7

(i) the velocity

(ii) the value of stream function

(d) Write short notes on any two of the following : 7

(i) Circulation and vorticity

(ii) Stream function and velocity potential

(iii) Rotational & Irrotational Flow

Q. 3. (a) What is an impulse-momentum equation. 2

(b) State and prove Bernoulli's equation. List the assumptions which are made while deriving Bernoulli's equation. 7

(c) The following data relate to an orifice meter :

Diameter of the pipe = 240 mm

Diameter of the orifice = 120 mm

Sp. gravity of oil = 0.88

Reading of differential manometer = 400 mm of mercury

Coefficient of discharge of the meter = 0.65

Determine the rate of flow of oil. 7

(d) In a 45° bend rectangular air duct of 1 m^2 cross-sectional area is gradually reduced to 0.5 m^2 area. Find the magnitude and direction of force required to hold the duct in position if the velocity of flow at 1 m^2 section is 10 m/s and pressure is 30 kN/m^2. (Take specific weight of air as 0.0116 kN/m^2) 7

Q. 4. (a) Differentiate between a laminar flow and a turbulent flow. 2

(b) A crude oil of viscosity 0.9 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 120 mm and length

12 m. Calculate the difference of pressure at two ends of the pipe, if 785 N of oil is collected in a tank in 25 seconds. 7

(c) Derive Darcy-Weisbach equation for loss of head due to friction in pipe flow. 7

(d) A piping system consists of three pipes arranged in series; the lengths of the pipes are 1200 m, 750 m and 600 m and diameters 750 mm, 600 mm and 450 mm respectively : 7

(i) Transform the system to an equivalent 450 mm diameter pipe.

(ii) Determine an equivalent diameter for the pipe, 2550 m long

Q. 5. (a) Explain the principle of dimensional homogeneity. 2

(b) Show that the lift F_L of an aerofoil can be expressed as (using Buckingham's π-theorem) 7

$$F_L = \rho V^2 d^2 \phi \left(\frac{\rho V d}{\mu}, \alpha \right)$$

where ρ = mass density, V = velocity of flow d = characteristic depth, α = Angle of incidence and μ = coefficient of viscosity

(c) Define the following dimensionless numbers and state their significance for fluid flow problems (any two) : 7

(i) Reynolds number

(ii) Froude's number

(iii) Mach's number

(d) An oil of specific gravity 0.92 and viscosity 0.03 poise is to be transported at the rate of 2500 litres/sec, through a 1.2 m diameter pipe. Tests were conducted on a 12 cm diameter pipe using water at 20°C. If the viscosity of water at 20°C is 0.01 poise, find :

(i) Velocity of flow in the model

(ii) Rate of flow in the model 7