CBCS SCHEME

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18AU42

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

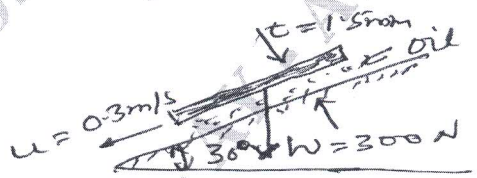
Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Assume missing data suitably.***

Module-1

1 a. Define Dynamic Viscosity. **(02 Marks)**

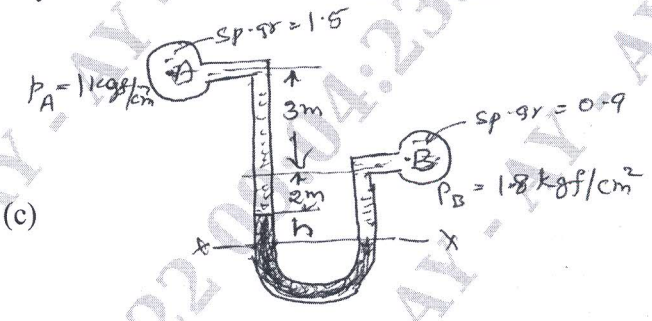
b. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8m × 0.8m and an inclined plane with angle of inclination 30° as shown in the following Figure Q1(b). The weight of the square plate is 300N and it slides down the inclined plane with a uniform velocity of 0.3m/s. Thickness of oil film is 1.5mm. **(08 Marks)**

Fig. Q1(b)



c. A differential manometer is connected at two points A and B of two pipes as shown in the Figure Q1(c). The pipe A contains a liquid of Sp.gr = 1.5 while pipe B contains a liquid of Sp.gr = 0.9. The pressure at A and B are 1kgf/cm^2 and 1.8kgf/cm^2 respectively. Find the difference in mercury level in the differential manometer. **(10 Marks)**

Fig. Q1(c)



OR

2 a. A rectangular plane surface is 2m wide and 3m deep. It lies in vertical plane in water. Determine the total pressure and position of center of pressure on the plane surface when its upper edge is horizontal and i) Coincides with water surface ii) 2.5m below the free water surface. **(10 Marks)**

b. What is i) Surface Tension ii) Capillarity? **(04 Marks)**

c. A open tank contain water upto a depth of 2m and above it an oil of sp.gr 0.9 for a depth of 1m. Find the pressure intensity i) at the interface of the two liquids and ii) at the bottom of the tank. **(06 Marks)**

Module-2

3 a. What is Buoyancy and Center of Buoyancy? **(04 Marks)**

b. Find the volume of water displaced and position of center of buoyancy for a wooden block of width 2.5m and depth 1.5m when it floats horizontally in water. The density of wooden block is 650 kg/m^3 and its length is 6.0m. **(10 Marks)**

c. What do you mean by i) Stable ii) Unstable and Neutral equilibrium? What is Metacentric height? **(06 Marks)**

OR

4 a. Derive Continuity equation in 3D (Cartesian). **(10 Marks)**

b. The velocity potential function is given by $\phi = 5(x^2 - y^2)$. Calculate the velocity components at the point (4, 5). **(10 Marks)**

Module-3

5 a. Derive Bernoulli's equation from first principle. Mention the assumptions made. **(10 Marks)**

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

OR

6 a. Derive an expression for flow through orifice meter. **(10 Marks)**

b. Find the discharge over a triangular notch of angle 60° when the head over the V notch is 0.3m. Assume $C_d = 0.6$. **(04 Marks)**

c. A rectangular channel 2.0m wide has a discharge of 250 LPS, which is measured by a right angled V notch. Find the position of the apex of the notch from the bed of channel if maximum depth water is not to exceed 1.3m. Take $C_d = 0.62$. **(06 Marks)**

Module-4

7 a. Explain Buckingham's π Theorem. **(10 Marks)**

b. A fluid having density ρ and dynamic viscosity μ flows through a pipe of diameter d with velocity v. Find the expression for force causing the flow by Rayleigh's method. **(10 Marks)**

OR

8 a. Derive Darcy Weisbach equation for head loss due to friction in pipe. **(10 Marks)**

b. Water is flowing through a pipe of diameter 200mm with velocity 3m/s. A circular solid plate of diameter 150mm placed in the pipe to obstruct the flow. Find the head loss due to contraction if coefficient of contraction is 0.62. **(10 Marks)**

Module-5

9 a. Derive Hagen – Poiseuille equation for viscous flow through pipes. **(10 Marks)**

b. Water at 15°C flows between two large parallel plates at a distance of 1.6mm apart. Determine i) Maximum velocity ii) Pressure drop per unit length and iii) The shear stress at the walls of the plates if average velocity is 0.2m/s. The viscosity of water at 15°C is given as 0.01 poise. **(06 Marks)**

c. Explain i) Momentum thickness ii) Energy thickness.. **(04 Marks)**

OR

10 a. Calculate Stagnation pressure and density on the stagnation point on the nose of a plane , which is flying at 800km/hr through still air having a pressure of 8.0N/cm^2 and Temperature -10°C. Take R = 287 J/kg K at K = 1.4. **(10 Marks)**

b. Define i) Mach Number ii) Mach Cone. **(10 Marks)**

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