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15AU42

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Fluid Mechanics

Time: 3 hrs.

Max. Marks: 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1   a. Define the following fluid properties.
        i) Density   ii) Weight density   iii) Specific volume   iv) Specific gravity.   **(08 Marks)**
    b. The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 6 poise, the shaft is of diameter 0.4m and rotates at 190rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5mm.   **(08 Marks)**

OR

2   a. Derive an expression for the force exerted on a submerged vertical plane surface by the static liquid and locate the position of center of pressure.   **(08 Marks)**
    b. Determine the total pressure on a circular plate of diameter 1.5m which is placed vertically in water in such a way that the centre of the plate is 3m below the free surface of water. Find the position of centre of pressure also.   **(08 Marks)**

Module-2

3   a. How will you determine the meta centric height of a floating body experimentally? Explain with neat sketch.   **(08 Marks)**
    b. A Solid cylinder of diameter 4m has a height of 3m. Find the meta centric height of the cylinder when it is floating in water with its axis vertical the specific gravity of the cylinder = 0.6.   **(08 Marks)**

OR

4   a. Obtain an expression for continuity equation for a three dimensional flow.   **(08 Marks)**
    b. The velocity vector in a fluid flow is given $V = 4x^3i - 10x^2yj + 2tk$. Find the velocity and acceleration of fluid particle at (2, 1, 3) at time t = 1.   **(08 Marks)**

Module-3

5   a. Derive Euler's equation of motion along a stream line for an ideal fluid.   **(08 Marks)**
    b. The water is flowing through a pipe having diameters 20cm and 10cm at sections 1 and 2 respectively, the rate of flow through pipe is 35 litres/sec. The section 1 is 6m above datum and section 2 is 4m above datum, if the pressure at the section 1 is 39.24 N/cm^2, find the intensity of pressure at section 2.   **(08 Marks)**

OR

6   a. What is a venturimeter? Derive an expression for the discharge through a venturimeter.   **(08 Marks)**
    b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of oil of specific gravity 0.8, the discharge of oil through venturimeter is 60 litres/sec. Find the reading of the oil mercury differential monometer. Take $C_d = 0.98$.   **(08 Marks)**

Module-4

7 a. State Buckingham's π-theorem. Describe the Buckingham's π-theorem for dimensional analysis. **(08 Marks)**

   b. The efficiency η of a fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity w, diameter D of a the rotor and the discharge Q. Express η in terms of dimensionless parameters using Buckingham's π-theorem. **(08 Marks)**

OR

8 a. How will you determine the loss of head due to friction in pipes by using :
   i) Darcy formula   ii) Chezy's formula. **(08 Marks)**

   b. Find the diameter of a pipe of length 2000m when the rate of flow of water through the pipe is 200 litres/sec and the head lost due to friction is 4m. Take the value of C = 50 in Chezy's formula. **(08 Marks)**

Module-5

9 a. Explain the flow of viscous fluid through circular pipe. **(08 Marks)**

   b. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10m. Calculate the difference of pressure at the two ends of the pipe, if 100kg of the oil of collected in a tank in 30 seconds. **(08 Marks)**

OR

10 a. Explain the drag and lift concepts in an arbitrary shaped solid body placed in a real fluid. **(08 Marks)**

   b. A flat plate 1.5m × 1.5m moves at 50km/hr in stationary air of density 1.15Kg/m³, if the coefficients of drag and lift are 0.15 and 0.75 respectively, determine :
   i)   Lift force
   ii) The drag force
   iii) Resultant force
   iv) Power required to keep the plate in motion. **(08 Marks)**

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