CBCS SCHEME

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21AU43

Fourth Semester B.E. Degree Examination, June/July 2024
Fluid Mechanics and Fluid Machines

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following fluid properties and mention SI units
i) Weight density i) Superface tension iii) Capillarity iv) Bulk modulus **(04 Marks)**

b. Derive an expression for surface tension on a droplet. **(06 Marks)**

c. An open tank contains water upto a depth of 2m and above it, an oil of specific gravity 0.9 for a depth of 1m. Find the pressure intensity at :
i) Interface of 2 liquids ii) the bottom of the tank **(10 Marks)**

OR

2 a. Write short note on hydrostatic pressure of a static fluid. **(04 Marks)**

b. A hydraulic ram has 30cm diameter and a plunger of 4.5cm in a hydraulic lift system. Find the weight lifted by the hydraulic press. Find the weight lifted by the hydraulic press when the force applied at the plunger is 500N. **(06 Marks)**

c. The right limb of a U-tube monometer contain mercury and is open to the atmosphere. The left limb is connected to a pipe that has a liquid of specific gravity 0.9. The centre of pipe is 12cm below the mercury level in the right limb. Find the pressure of the liquid if the difference of mercury level in the 2 limbs is 20cm. **(10 Marks)**

Module-2

3 a. Define the following terms :
i) Buoyancy ii) centre of buoyancy iii) metacentre iv) metacentric height. **(04 Marks)**

b. Explain different conditions of floating and sub merged bodies with neat sketches. **(10 Marks)**

c. A rectangular base is 5m long, 3m, wide and 1.2m, high. The depth of immersion of the base is 0.8m in sea water. If the centre of gravity is 0.6m above the bottom off the base, determine the meta centric height. The density for sea water $= 1025 Kg/m^3$. **(06 Marks)**

OR

4 a. Define the following terms :
i) Steady flow ii) Tubulent flow iii) Uniform flow iv) Rotational flow **(04 Marks)**

b. Derive an expression for continuity equation in 3D with a neat sketch. **(06 Marks)**

c. A fluid flow is represented by $\vec{V} = x^2y\hat{i} + y^2z\hat{j} - (2xyz + yz^2)\hat{k}$. Prove that it is a case of possible steady incompressible flow. **(10 Marks)**

Module-3

5 a. Explain various forces acting on a fluid flow with mathematical equations. **(04 Marks)**

b. Derive an expression for Bernoulli's equations of fluid flow. Mention some assumptions. **(10 Marks)**

c. Water is flowing through a pipe of 5cm diameter under a pressure of $29.43 N/cm^2$ with velocity 2m/s. Find the total head of water which is 5m above the datum line. **(06 Marks)**

OR

6 a. Derive an expression for coefficient of discharge in venturimeter. **(10 Marks)**

b. A horizontal venturimeter with inlet diameter 20cm, and throat diameter 10cm is used to measure water flow. The pressure at the inlet is 17.658N/cm^2 and vacuum pressure at the throat is 30cm of mercury. Find the discharge. Take G = 0.98. **(10 Marks)**

Module-4

7 a. Derive an expression for the loss of head due to friction in pipes. **(10 Marks)**

b. Determine the flow rate of water in a pipe of 20cm diameter and 50m length. One end of pipe is connected to a tank and other end of the pipe is open to atmosphere. The pipe is horizontal and height of water in the tank is 4m above the pipe centre. Consider all the minor losses and f = 0.009 is Darcy's – Weisbach equation formula. **(10 Marks)**

OR

8 a. Explain the terms :
i) HEL ii) Displacement thickness iii) Boundary layer thickness **(10 Marks)**

b. A fluid of viscosity 0.7Ns/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100mm. The shear stress at the pipe wall is 196.2N/m^2 hence determine :
i) Pressure gradient ii) average velocity iii) Reynold's number of the flow. **(10 Marks)**

Module-5

9 a. Determine the dimensions of the qualities.
i) Angular velocity ii) Angular acceleration iii) Discharge
iv) Force v) Dynamic viscosity **(10 Marks)**

b. The resisting force R of an aircraft depends on the length of the aircraft ℓ velocity V air viscosity μ air density ρ and bulk modulus of air K. Express the functional relationship between these variable and the resisting force. **(10 Marks)**

OR

10 a. Explain the working of centrifugal pumps with a neat sketch. Also mention the function of different parts in centrifugal pumps **(10 Marks)**

b. Derive an expression for work done by a centrifugal pump in water. **(10 Marks)**

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