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Fourth Semester B.E. Degree Examination, July/August 2022
Fluid Mechanics

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: i) Viscosity ii) Specific weight iii) Specific volume iv) Specific gravity v) Density. (10 Marks)
- b. Derive the expression for surface tension of liquid droplet. (06 Marks)
- c. Two horizontal plates are placed 1.25cm apart, the space between them being filled with oil of viscosity 14 poises. Calculate the shear stress in oil if upper plate is moved with a velocity of 2.5m/s. (04 Marks)

OR

- 2 a. State and prove Pascal's law. (10 Marks)
- b. A rectangular plane surface is 2m wide and 3m deep. It lies in vertical plane in water. Determine the total pressure and position of centre 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)

Module-2

- 3 a. Define the following: i) Buoyancy ii) centre of buoyancy iii) Meta centre iv) Meta centric height. (10 Marks)
- b. A solid cylinder of diameter 4m has a height of 3 metres. 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. (10 Marks)

OR

- 4 a. Obtain an expression for continuity equation for a three dimensional flow. (10 Marks)
- b. A 30cm diameter pipe, conveying water branches in to two pipes of diameters 20cm and 15cm respectively. If the average velocity in the 30cm diameter pipe is 2.5m/s. Find the discharge in this pipe. Also determine the velocity in 15cm pipe. If the average velocity in 20cm diameter pipe is 2m/s. (10 Marks)

Module-3

- 5 a. Derive Bernoulli's equation from Euler's equation with assumptions and limitations. (10 Marks)
- b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and the vacuum pressure at the throat is 30cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$. (10 Marks)

OR

- 6 a. What is venturimeter? Derive an expression for discharge through the venturimeter. (10 Marks)
- b. A pipe line carrying oil of specific gravity 0.87, changes in diameter 200mm diameter at a position A to 500mm diameter at position 'B' which is 4 meters at a higher level. If the pressure at A and B are 9.81N/cm^2 and 5.886N/cm^2 respectively and the discharge is 200 lit/sec determine the loss of head and direction of flow. (10 Marks)

Module-4

- 7 a. What is dimensional analysis? State Buckingham π theorem and explain the procedure to determine π groups. (10 Marks)
- b. The efficiency η of a fan depends on density ρ dynamic viscosity μ of the fluid, angular velocity w , diameter D of the rotor and the discharge Q . Express η in terms of dimensionless parameters. (10 Marks)

OR

- 8 a. Derive Darcy-Weisbach expression for friction head in a pipe flow. (10 Marks)
- b. A crude oil of kinematic viscosity 0.4 stroke is flowing through a pipe of diameter 300mm. At the rate of 300lt/sec. Find the head lost due to friction for a length of 50m of the pipe. (10 Marks)

Module-5

- 9 a. Show that for laminar flow through a circular pipe the mean velocity is half of the maximum velocity. (10 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 end of the pipe. If 100kg of the oil is collected in a tank in 30sec. Assume laminar flow. (10 Marks)

OR

- 10 a. Obtain an expression for velocity of sound in a compressible fluid in terms of change of pressure and change of density. (10 Marks)
- b. A man weighing 90kg and descends to the ground from an aeroplane. With the help of a parachute against the resistance of air. The velocity with which the parachute, which is hemispherical in shape, comes downs is 20m/s. Find the diameter of parachute. Assume $C_D = 0.5$ and density of air = 1.25kg/m^3 . (10 Marks)

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