CBCS SCHEME

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21AU43

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.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.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define the following:
   i) Density
   ii) Specific gravity
   iii) Weight density
   iv) Viscosity
   v) Specific volume
   vi) Surface tension. **(06 Marks)**

b. Define capillarity and also derive the expression for capillary rise. **(06 Marks)**

c. A vertical cylinder of diameter 180mm rotates concentrically inside another cylinder of diameter 181.2mm. Both the cylinders are 300mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of the fluid if a torque of 20Nm is required to rotate the inner cylinder at 120rpm. **(08 Marks)**

OR

2 a. State Pascal's law and prove it. **(06 Marks)**

b. Explain U-tube differential manometer with sketch and derive pressure difference in it. **(06 Marks)**

c. A circular plate 3m diameter is immersed in water in such a way that its greatest and least depths below the free surface are 4m and 1.5m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. **(08 Marks)**

Module-2

3 a. What are the conditions of equilibrium of a floating and a submerged body? **(06 Marks)**

b. How will you determine the metacentric height of a floating body experimentally? Explain with sketch. **(06 Marks)**

c. A solid cylinder of diameter 4m has a height of 3 metres. Find the metacentric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of cylinder = 0.6. **(08 Marks)**

OR

4 a. List and explain the types of fluid flow. **(08 Marks)**

b. Derive the continuity equation for 3-dimension Cartesian co-ordinates. **(08 Marks)**

c. Define the terms:
   i) Velocity potential function
   ii) Stream function. **(04 Marks)**

Module-3

5 a. Derive Euler's equation of motion for ideal fluid and hence deduce Bernoulli's equation of motion state assumptions made. **(10 Marks)**

b. A non uniform part of a pipeline 5m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read $20N/cm^2$ and $12.5N/cm^2$. If the diameters at the upper and lower ends are 15cm and 10cm respectively. Determine the quantity of water flowing per second. **(10 Marks)**

OR

6 a. Derive an expression for rate of flow through venturimeter. **(08 Marks)**

b. Derive an expression for discharge over a triangular notch or weir. **(08 Marks)**

c. Determine the height of a rectangular weir of length 6m to be built across a rectangular channel. The maximum depth of water on the upstream side of the weir is 1.8m and discharge is 2000 litres/s. Take $C_d = 0.6$ and neglect end contractions. **(04 Marks)**

Module-4

7 a. Derive the loss of head due to friction in pipes by using Darcy formula and Chezy's formula. **(12 Marks)**

b. An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200mm at the rate of 60 litres/s. Find the head lost due to friction for a 500m length of pipe. Find the power required to maintain this flow. **(08 Marks)**

OR

8 a. Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. **(10 Marks)**

b. Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section. **(10 Marks)**

Module-5

9 a. 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)**

b. Define similitude. Explain types of similarities. **(06 Marks)**

c. Define the term and explain:
i) Reynold's Number ii) Mach Number. **(04 Marks)**

OR

10 a. Derive an expression for work done, without clearance, when the compression is polytropic. **(08 Marks)**

b. What is the purpose of multistaging in reciprocating compressors? **(04 Marks)**

c. Sketch a layout diagram of centrifugal pump and explain its working principle. **(08 Marks)**

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