CBCS SCHEME

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18ME43

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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 terms with S.I. units:
i) Specific volume
ii) Relative density, S
iii) Kinematic viscosity
iv) Compressibility, C
v) Shear stress. **(10 Marks)**

b. Dynamic viscosity of oil used for lubrication between a shaft and sleeve is 6 poise. Shaft diameter is 0.4m and rotates at 190rpm. Determine the power lost in the bearing for a sleeve length of 90mm. Thickness of oil film is 1.2mm. Determine the shear stress. **(10 Marks)**

OR

2 a. Define capillary rise. Derive as expression for capillary rise of water in a tube of diameter d. **(06 Marks)**

b. Define and derive an expression for the Pascal law of static fluid. **(06 Marks)**

c. A circular plate 3.0m diameter is immersed in water such that its greatest and least depth below the free surface are 4.0m and 1.5m respectively. Determine total force on the plate and its location. **(08 Marks)**

Module-2

3 a. Define Metacentre and centre of Buoyance. Explain conditions of equilibrium for floating bodies. **(08 Marks)**

b. A cylindrical buoy is 2m in diameter, 2.5m long and weighs 2.2 metric tones. Density of sea water is 1025kg/m^3. Check the condition of cylinder for floating. **(12 Marks)**

OR

4 a. Obtain an expression for (3) three dimensional continuity equation in Cartesian co-ordinates. **(08 Marks)**

b. Differentiate between:
i) Steady flow and unsteady flow.
ii) Rotation and Irrotational flow.
iii) Viscous and Turbulent flow. **(06 Marks)**

c. The stream function for a flow is given by $\psi = 2xy$. Determine the velocity at a point P(2, 3) and find velocity potential function. **(06 Marks)**

Module-3

5 a. Derive Bernoulli's equation for fluid flow and state the assumptions. **(08 Marks)**

b. With neat sketch, explain working of the venturimeter fitted in a pipeline. **(06 Marks)**

c. Determine the velocity and discharge of oil flow in a pipe, when the difference of mercury level in a differential u-Tube manometer connected to Pitot-tube is 100mm. Assume coefficient of pitot-tube is 0.98 and special gravity of oil is 0.80, diameter 200mm. **(06 Marks)**

OR

6 a. For viscous flow through a circular pipe derive Hagen-Poiseuille equation. **(10 Marks)**

b. For a pipeflow, due to sudden enlargement of diameter of pipe from 240mm to 480mm, kinetic head increases by 10mm. Determine the rate of water flow in lit/sec. **(10 Marks)**

Module-4

7 a. Explain following terms:
   i) Boundary layer
   ii) Displacement thickness
   iii) Momentum thickness
   iv) Lift, drag. **(10 Marks)**

b. A man descends to the ground from an aeroplane with the help of a parachute which is hemispherical having a diameter of 4.0m against the resistance of air with a uniform velocity of 25m/sec. Find the weight of the man if the weight of parachute is 9.81N. Assume $C_D = 0.6$ and density of air is $1.25 kg/m^3$. **(10 Marks)**

OR

8 a. List four Non-Dimensional Numbers used in model similitude and obtain relations for the numbers. **(10 Marks)**

b. The frictional torque T of a disc of diameter D rotating at a speed 'N' in a fluid of viscosity 'M' and density 'ρ' in a turbulent flow is given by $T = \rho N^2 D^5 f\left(\frac{u\ell}{\rho N D^2}\right)$. Use dimensional analysis method. **(10 Marks)**

Module-5

9 a. Derive relation for velocity of sound in compressible fluid flow at adiabatic conditions. **(10 Marks)**

b. Explain the terms:
   i) Subsonic flow ii) Supersonic flow. **(05 Marks)**

c. A projectile travels in air of pressure $10.104 N/cm^2$ at 10°C with speed of 1500km/hour. Determine Mach number and Mach angle. Assume K = 1.4, R = 287J/kg K. **(05 Marks)**

OR

10 a. Obtain an expression for stagnation pressure in compressible fluid flow. **(10 Marks)**

b. Explain the necessity of CFD and list the applications of CFD. **(10 Marks)**

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