CBCS SCHEME

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18ME43

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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 with SI units :
i) weight density ii) kinematic viscosity iii) capillarity iv) Bulk modulus. **(08 Marks)**

b. What is the effect of pressure and temperature on mass density? **(04 Marks)**

c. A cubical block of 200 mm edge and weight 196 N is allowed to slide down an inclined plane 20° to horizontal on which there is thin film of oil of viscosity 2.156×10^{-3} Pa-See. What terminal velocity will be attained by the block. It the film thickness is estimated to be 0.025 mm. **(08 Marks)**

OR

2 a. Define the following :
i) Atmospheric pressure ii) Vacuum pressure iii) Absolute pressure. **(06 Marks)**

b. Derive an expression for the hydrostatic force exerted on a plane surface immersed vertically in a liquid and to locate centere of pressure. **(08 Marks)**

c. Find intensity of pressure required to suck fruit juice by a straw through a height of 200 mm from a vessel in absolute scale. Take relative density of fruit juice as 1.20. **(06 Marks)**

Module-2

3 a. Explain the following terms :
i) Buoyancy ii) Centere of buoyancy iii) Meta centre iv) Meta centric height **(06 Marks)**

b. A rectangular pontoon is 5 m long, 3 m wide and 1.2 m high. The depth of immersion of the pontoon is 0.8 m in seawater. If the centre of gravity is 0.6 m above the bottom of the pontoon. Determine the metacentric height. The density of sea water = 1025 Kg/m^3. **(08 Marks)**

c. Explain the conditions of equilibrium of submerged and floating bodies. **(06 Marks)**

OR

4 a. Explain the following :
i) Study and unstudy flows
ii) Uniform and nonuniform flows
iii) Laminar and turbulent flows
iv) Compressible in incompressible flows. **(08 Marks)**

b. Derive continuity equation for 3D, flow for Cartesian coordinate system. **(08 Marks)**

c. Calculate the unknown velocity component so that the following velocity components represent a possible case of incompressible flow
$u = 2x^2$, $v = xyz$, $w = ?$ **(04 Marks)**

Module-3

5 a. Derive Euler's equation of motion along a stream line, Also derive Bernoulli's equation from Euler's equation of motion and list the assumptions made for deriving Bernoulli's equations. **(10 Marks)**

b. A 50 mm diameter tube gradually expands to 100 mm diameter in a length of 10 m. If the tube makes an angle of 20° in the upward direction with the horizontal. Determine the pressure at the exist. If the tube carries a discharge of 3.125 liters/sec and the inlet pressure is $60 kN/m^2$, when
i) When there is no loss of energy
ii) Loss of energy is 0.2 m, flow being upwards. **(10 Marks)**

OR

6 a. Derive Darcy-Weisbach relation for fluid flow through a pipe. **(04 Marks)**

b. Differentiate between venturimeter and orifice meter. **(08 Marks)**

c. Prove that the ratio of maximum velocity to average velocity for Laminar Flow between two stationary parallel plates is 1.5. **(08 Marks)**

Module-4

7 a. Explain the terms :
i) Lift ii) Drag iii) Displacement thickness iv) Momentum thickness. **(10 Marks)**

b. A flat plate 1.5 m × 1.5 m moves at 50 kM/hr in stationary air of density $1.15 Kg/m^3$. If the coefficient of drag and life are 0.15 and 0.75 respectively. Determine :
i) The life force
ii) The drag force
iii) The resultant force
iv) The power required to keep the plate in motion. **(06 Marks)**

c. Write a short note on boundary layer separation method to control it. **(04 Marks)**

OR

8 a. What is fundamental quantities and derived quantities with respect to dimensional analysis. **(04 Marks)**

b. Explain the following :
i) Geometric similarity ii) Kinematic similarity iii) Dynamic similarity **(06 Marks)**

c. Using Buckingham's π theorem show that discharge of a centrifugal pump is given by
$Q = ND^3\phi\left[\frac{gH}{N^2D^2}; \frac{\mu}{ND^2\rho}\right]$. **(10 Marks)**

Module-5

9 a. Derive an expression for velocity of sound in terms of bulk modulus. **(08 Marks)**

b. Define the following :
i) Mach number ii) Sub sonic flow iii) Sonic flow iv) Super Sonic flow. **(06 Marks)**

c. An aeroplane is flying at on height of 15 km , where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0 (Mach number). Assuming K = 1.4 and R = 287 J/Kg° K. Find the speed of the plane. **(06 Marks)**

OR

10 a. Derive an expression for stagnation temperature. **(06 Marks)**

b. Write a note on oblique and normal shocks. **(04 Marks)**

c. Define; computational fluid dynamics (CFD) also mention their applications and limitations. **(10 Marks)**

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