CBCS SCHEME

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17ME44

Fourth Semester B.E. Degree Examination, July/August 2022
Fluids 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 SI units : i) Weight density ii) Specific gravity iii) Dynamic viscosity. **(06 Marks)**

b. Define Capillarity and derive an expression for Capillary rise. **(08 Marks)**

c. If the velocity distribution over a plate is given by $u = \frac{2}{3} y - y^2$ in which u is the velocity in meter per second at a distance y meter above the plate. Determine the shear stress at y = 0 and y = 0.15m. Take dynamic viscosity of fluid as 8.63 poises. **(06 Marks)**

OR

2 a. State and prove Hydrostatic Law. **(06 Marks)**

b. Define i) Buoyancy ii) Metacentre iii) Metacentric height. **(06 Marks)**

c. A rectangular pontoon is 5m long, 3m wide and 1.20m high. The depth of immersion of pontoon is 0.80m in sea water. If the centre of gravity is 0.6m above the bottom of the pontoon , determine the meta centric height. The density of sea water = 1025 kg/m^3. **(08 Marks)**

Module-2

3 a. Differentiate between :
i) Steady flow and Unsteady flow ii) Laminar flow and Turbulent flow. **(04 Marks)**

b. Derive the Continuity equation for 3 – Dimensional flow in Cartesian co-ordinates. **(08 Marks)**

c. The velocity components in a two dimensional flow are
$u = y^3/3 + 2x - x^2y$ and $v = xy^2 - 2y - x^3/3$.
Show that these components represents a possible case of an irrotational flow. **(08 Marks)**

OR

4 a. Derive an expression for discharge through venturimeter. **(10 Marks)**

b. The water is flowing through a taper pipe of length 100m having diameters 600mm at the upper end and 300mm at the lower end, at the rate of 50 litre/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. **(10 Marks)**

Module-3

5 a. Define Reynolds number. What is its significance? List the characteristic of laminar flow. **(08 Marks)**

b. A crude oil of viscosity 0.97 poise and specific gravity 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10m. Calculate the difference of pressure at the two ends of pipe, if 100kg of the oil is collected in a tank in 30 seconds. **(12 Marks)**

OR

6 a. Derive the Darcy Weisbach equation. **(08 Marks)**

b. Define Hydraulic gradient line and Total energy line. **(04 Marks)**

c. Find the head lost due to friction in a pipe of diameter 300mm and length 50m through which water is flowing at a velocity of 3 m/s using
i) Darcy formula ii) Chezy's formula for which C = 60. **(08 Marks)**

Module-4

7 a. Define i) Boundary layer ii) Boundary layer thickness iii) Drag iv) Lift. **(08 Marks)**

b. Experiments were conducted in a wind tunnel with a wind speed of 50km/hour on a flat plat of size 2m long and 1m wide. The density of air is 1.15 kg/m^3. The coefficients of lift the drag are 0.75 and 0.15 respectively. Determine i) The lift force ii) The drag force iii) The resultant force iv) Direction and resultant force v) Power exerted by air on the plate. **(12 Marks)**

OR

8 a. Explain different types of Similitude. **(06 Marks)**

b. Explain Rayleighs method of dimensional analysis. **(06 Marks)**

c. Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$, where H is the head causing flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(08 Marks)**

Module-5

9 a. Define the following terms : i) Mach number ii) Mach cone iii) Zone of action iv) Subsonic flow v) Supersonic flow vi) Sonic flow. **(12 Marks)**

b. An Aeroplane is flying at an height of 15km where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg K. Find the speed of the plane. **(08 Marks)**

OR

10 a. Explain the meaning of CFD and its applications. **(06 Marks)**

b. Define the following terms and write the relevant equations for same :
i) Stagnation temperature ii) Stagnation pressure. **(06 Marks)**

c. Derive and expression for velocity of sound in a fluid. **(08 Marks)**

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