CBCS SCHEME

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18ME43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: ***1. Answer any FIVE full questions, choosing ONE full question from each module.***
2. Any missing data assumed suitably.

Module-1

1 a. Define the following terms with SI units:
(i) Mass density (ii) Kinematic viscosity
(iii) Capillarity (iv) Compressibility **(10 Marks)**

b. An oil film thickness 1.5 mm is used for lubrication between a square plate of size 0.9 m × 0.9 m slides down as a inclined plane having an inclination of 20° with horizontal. The weight of the squire plate is 392.4 N and it slides down the plane with a uniform velocity of 0.2 m/s. Find the kinematic viscosity of oil. Specific gravity of oil is 0.7. **(10 Marks)**

OR

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

b. Derive an expression for total pressure torque and depth of centre of pressure for an inclined plane surface submerged in liquid. **(06 Marks)**

c. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of manometer is open to atmosphere. Find the vacuum pressure in a pipe, if the difference of mercury level in two limbs is 40 cms and height of the fluid in the left from the centre of pipe is 15 cm below. **(08 Marks)**

Module-2

3 a. Define the following terms:
(i) Buoyancy
(ii) Centre of buoyancy
(iii) Meta centric height
(iv) Meta centre **(08 Marks)**

b. Explain different types of fluid flow. **(04 Marks)**

c. Derive continuity equations in Cartesian coordinated for a fluid flow 3 dimensional steady incompressible flow. **(08 Marks)**

OR

4 a. Write an expression for acceleration of fluid in x, y and z directions. Differentiate between local and convective acceleration. **(06 Marks)**

b. The velocity potential function (ϕ) is given by the expression $\phi = -2 \ln (x^2 + y^2)$. Show that it represents a possible case of fluid flow. **(06 Marks)**

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

Module-3

5 a. With a suitable assumption, derive a Bernoulli's equation. **(07 Marks)**

b. A pipe line is carrying an oil of specific gravity 0.87, the diameter of pipe charges from 200 mm at section A to 500 mm at section 'B' which is 4 m higher than A. If the pressure at 'A' and 'B' is 100 kPa and 60 kPa respectively and if the discharge is 200 kg/s. Determine:
(i) Loss of head (ii) Flow direction. **(06 Marks)**

c. Obtain the Euler's equation of motion along a stream line. State the assumptions made. **(07 Marks)**

OR

6 a. Derive Hagen Poiseuille equation for laminar flow through a circular pipe. **(06 Marks)**

b. Three pipes of length 800 m, 500 m and 400 m of diameters 500 mm, 400 mm and 300 mm respectively are connected in series, these pipes are replaced by a single pipe of 1700 m. Find the diameter of the single pipe. **(10 Marks)**

c. Write a note on venture-meter. **(04 Marks)**

Module-4

7 a. Explain boundary layer separation and discuss methods of controlling boundary layer separation. **(10 Marks)**

b. What is a similitude's? Explain the following:
(i) Geometric similarity
(ii) Dynamic similarity **(10 Marks)**

OR

8 a. The frictional torque of a disc of diameter 'D' depends on speed 'N' in a fluid dynamic viscosity μ and density of fluid ρ in a turbulent fluid flow by Buckingham's PI method develop a frictional torque T. **(10 Marks)**

b. The resisting force 'F' of a plane during flight can be considered as dependent upon length of aircraft 'ℓ' velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variable and the resisting force using dimensional analysis. Explain the physical meaning of these groups. **(10 Marks)**

Module-5

9 a. Define stagnation properties. Obtain an expression for stagnation pressure of a compressible fluid interms of Mach number and pressure. **(08 Marks)**

b. A projectile travels in air of pressure 15 N/cm^2 at 10°C at a speed of 1500 km/hr. Find the Mach number and Mach angle. Take $\gamma = 1.4$ and R = 287 J/kgK. **(08 Marks)**

c. What is normal shock and oblique shocks? **(04 Marks)**

OR

10 a. Define the following terms:
(i) Mach number
(ii) Zone of action
(iii) Subsonic flow
(iv) Supersonic flow
(v) Transonic flow **(10 Marks)**

b. Explain CFD and mention its applications. **(06 Marks)**

c. Explain one dimensional flow. **(04 Marks)**

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