CBCS SCHEME

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17ME44

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
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. Explain the following properties of fluids, state their units of measurements in S.I.
(i) Weight density (ii) Specific volume
(iii) Dynamic viscosity (iv) Kinematic viscosity **(08 Marks)**

b. Explain the phenomenon of capillarity. Obtain an expression for capillarity rise of a liquid. **(06 Marks)**

c. Find the kinematic viscosity of an oil having density 981 kg/m^3. The shear stress at a point in oil is 0.2452 N/m^2 and velocity gradient at that point is 0.2 per second. **(06 Marks)**

OR

2 a. What do you understand by
(i) total pressure
(ii) centre of pressure
(iii) gauge pressure
(iv) vacuum pressure **(08 Marks)**

b. A circular plate 3m diameter is immersed in water in such a way that its greatest and least depth 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. **(06 Marks)**

c. A position of 15696 kN displacement is floating in water. A weight of 245.25 kN is moved through a distance of 8m across the deck of pontoon, which tilts the pontoon through an angle 4°. Find meta centric height of the pontoon. **(06 Marks)**

Module-2

3 a. Distinguish between:
(i) Steady flow and unsteady flow
(ii) Uniform and non-uniform flow
(iii) Laminar and turbulent flow **(06 Marks)**

b. Derive continuity equation for the 3-dimensional flow in Cartesian coordinates. **(08 Marks)**

c. The stream function for a two dimensional flow is given by $\psi = 2xy$. Calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ. **(06 Marks)**

OR

4 a. What is pitot tube? How will you determine the velocity at any point with the help of pitot tube? **(06 Marks)**

b. A horizontal venturimeter with inlet dia 20 cms and throat dia 10 cms is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 lit/s. Find the reading of the oil mercury differential manometer. Take $C_d = 0.98$. **(08 Marks)**

c. A pipe of diameter 400 mm carries water at a velocity of 25 m/s. The pressure at the points A and B are given as 29.43 N/cm^2 and 22.563 N/cm^2 respectively. While the datum head at A and B are 28 m and 30 m. Find the loss of head between A and B. **(06 Marks)**

Module-3

5 a. Derive Hagen Poiseuille equation for laminar flow through a circular pipe. **(10 Marks)**

b. An oil of viscosity 0.2 NS/m^2 and specific gravity 0.85 flows through a circular pipe of diameter 75 mm and length 250 m. The rate of flow of oil though the pipe is 5 lps. Find the pressure drop in a length of 250 m and the shear stress at the pipe wall. **(10 Marks)**

OR

6 a. Derive Darcy-Weigh Bach equation for a fluid flow through a pipe. **(10 Marks)**

b. Determine the rate of flow of water through a pipe of diameter 20 cms and length 50 m when one end of the pipe is connected to a tank and the other end of the pipe is open to the atmosphere. The pipe is horizontal and height of water in the tank is 4m above the centre of the pipe. Consider all minor losses and take coefficient of friction f = 0.009. **(10 Marks)**

Module-4

7 a. Define: (i) Drag (ii) Lift (iii) Stream line body (iv) Bluff body (v) Displacement 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 coefficients of drag and lift are 0.15 and 0.75 respectively, determine:
(i) the lift force (ii) the drag force
(iii) the resultant force (iv) power required to keep the plate in motion **(10 Marks)**

OR

8 a. Define the terms dimensional analysis and model analysis. **(04 Marks)**

b. What are the methods of dimensional analysis? Describe the Rayleigh method of the dimensional analysis. **(06 Marks)**

c. Using Bucklingham's π-theorem, show that the velocity through a circular orifice is given $V = \sqrt{29H}\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$ where H is the head causing the flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the mass density and g is acceleration due to gravity. **(10 Marks)**

Module-5

9 a. Define the following terms:
(i) Internal energy (ii) Enthalpy (iii) Mach number
(iv) Subsonic (v) Supersonic **(10 Marks)**

b. A projectile travels at speed of 1500 km/hr at 20°C temperature and 0.1 MPa air pressure. Calculate the Mach number and Mach angle. Take $\gamma = 1.4$ for air and R = 287 J/kgK. **(10 Marks)**

OR

10 a. Explain the necessity of CFD. Mention its applications and limitations. **(10 Marks)**

b. Find the Mach number when an aeroplane is flying at 1100 km/hr through still air having a pressure of 7 N/cm^2 and temperature −5°C. Wind velocity may be taken as zero. Take R = 287.14 J/kgK. Calculate the pressure, temperature and density of air at stagnation point on the nose of the plane. Take $\gamma = 1.4$. **(10 Marks)**

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