CBCS SCHEME

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17AE/AS35

Third Semester B.E. Degree Examination, Feb./Mar. 2022
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. A cylinder of $0.6m^3$ in volume contains air at 50°C and 0.3M/mm2 absolute pressure. The air is compressed to $0.3m^3$. Find i) Pressure inside the cylinder assuming Isothermal process and ii) Pressure and temperature assuming Adiabatic process. Take K = 1.4. **(10 Marks)**

b. State Pascal's law and derive an expression for it. **(10 Marks)**

OR

2 a. Explain conditions of equilibrium of a floating and submerged bodies. **(10 Marks)**

b. Derive an expression for Total pressure and Center of pressure in case of vertical plane surface submerged in liquid. **(10 Marks)**

Module-2

3 a. Explain different types of Fluid flow. **(12 Marks)**

b. A 30cm diameter pipe , conveying water branches into two pipes of diameters 20cm and 15cm respectively. If the average velocity 30cm diameter pipe is 2.5m/s, find discharge in this pipe. Also determine the velocity in 15cm pipe if the average velocity in 20cm diameter pipe is 2m/s **(08 Marks)**

OR

4 a. Derive Integral form of Momentum equations. **(10 Marks)**

b. Derive 3d continuity equation in differential form for a 3d infinitesimal fluid element for steady incompressible flow. **(10 Marks)**

Module-3

5 a. State Bernoulli's statement and its assumptions. Derive Bernoulli's equation of fluid flow. **(10 Marks)**

b. Derive expression for rate of flow through an Orificemeter. **(10 Marks)**

OR

6 a. The resistance force R of a supersonic plane during flight can be considered as dependent upon the length of Aircraft (ℓ) , Velocity (V) , Air viscosity (μ) , Air density (ρ) and Bulk modulus of Air K. Express the functional relationship between the variables and the resisting force using Buckingham's π - theorem. **(12 Marks)**

b. What is Similitude? Explain different types of similarities existing between model and prototype. **(08 Marks)**

Module-4

7 a. Derive an expression for drag and lift. **(06 Marks)**

b. Differentiate between a Streamline body and Bluff Body. **(04 Marks)**

c. Find the displacement thickness, momentum thickness and energy thickness for the velocity distribution in the boundary layer given by

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2.$$ **(10 Marks)**

OR

8 a. Explain Boundary layer concept, with neat sketch. **(06 Marks)**
b. Derive an expression for drag force on a flat plate due to boundary layer. **(14 Marks)**

Module-5

9 a. A gas is flowing through a horizontal pipe at a temperature of 4°C. The diameter of the pipe is 8cm and at section 1 – 1 in this pipe, the pressure is 30.3N/cm^2 (gauge). The diameter of the pipe changes from 8cm to 4cm at section 2 – 2 , where pressure is 20.3N/cm^2 (gauge). Find the velocities of the gas at these sections assuming at isothermal process.
Take R = 287.14Nm/kg K and Atmospheric pressure = 10N/cm^2. **(14 Marks)**
b. Derive an expression for velocity of sound for Isothermal process and Adiabatic process. **(06 Marks)**

OR

10 a. An Airplane is flying at an altitude of 15km, where the temperature is -50°C. The speed of plane corresponds to Mach number of 1.6. Assuming K = 1.4 , R = 287J/kg K for air, find the speed of plane and Mach angle α. **(06 Marks)**
b. Derive an expression for Stagnation Pressure (P_s) , Stagnation Density (ρ_s) and Stagnation Temperature (T_s). **(14 Marks)**

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