CBCS SCHEME

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17AE/AS35

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Distinguish between the following :
i) Mass density and weight density
ii) Dynamic viscosity and kinematic viscosity
iii) Real Fluid and Ideal fluid. **(06 Marks)**

b. What is Cavitations? Write about the importance of cavitations studies in Fluid mechanics. **(04 Marks)**

c. Two Large plane surfaces are 2.4cm apart. The space between the surfaces is filled with the liquid having dynamic viscosity as 8.10×10^{-1} Ns/m^2. Calculate Force Required to pull a very thin surface area 0.5m^2 between two large plane surfaces at a speed of 0.6m/s. if :
i) Thin plate is at middle of two plane surfaces
ii) Thin plate is at 0.8cm distance from one plane surface. **(10 Marks)**

OR

2 a. State Pascal's law and prove it by deriving pressure relation. **(05 Marks)**

b. A circular plate of 3m diameter having concentric circular hole of 1.5m diameter is immersed in such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine total pressure and position of centre of pressure on one face of the plate. **(07 Marks)**

c. Define Buoyancy and explain the types of manometers. **(08 Marks)**

Module-2

3 a. List and explain different types of fluid flow. **(06 Marks)**

b. Water flows through a pipe AB 1.2m diameter at 3m/s and then passes through a pipe BC 1.5m diameter. At point C, the pipe branches as CD of 0.8m diameter and carries one third of flow in AB and CE with velocity 2.5m/s. Find the volume rate of flow in AB, velocity in BC, velocity in CD and diameter of CE. **(06 Marks)**

c. Define velocity potential and stream function. Also write the expression for velocity components and prove that product of slope of equipotential line and stream lines is (-1). **(08 Marks)**

OR

4 a. With neat sketch explain the types of motion. **(06 Marks)**

b. Sketch source, sink and Doublet and explain. **(06 Marks)**

c. Derive Navier stokes equation and write the importance. **(08 Marks)**

Module-3

5 a. Derive Euler's equation and write Bernoulli's equation with neat sketch. **(06 Marks)**

b. A pipe of constant diameter is bent by 135° from the Initial to final direction. Diameter of the pipe is 300mm and carries 250ℓitres/sec of water. Pressure of water is 39.24N/cm^2 Find the magnitude and direction of resultant force on the bend. **(06 Marks)**

c. Write about :
   i) Venturimeter
   ii) Orifice meter
   iii) Pitot tube
   Also write its Merits and Demerits. **(08 Marks)**

OR

6 a. An aircraft is flying at a height of 10km altitude and at a speed of M = 0.5. The thrust (T) developed by a propeller in an Aircraft depends on angular velocity (w), speed of aircraft (v) diameter (D), Dynamic Viscosity (μ), Density (ρ) and speed of sound (C). Find the expression for thrust developed by dimensional analysis. **(08 Marks)**

b. List the Dimension less numbers used in fluid mechanics and write the expression. **(06 Marks)**

c. The pressure drop in an aircraft model of size 1:50 of its prototype is $4N/cm^2$. The model is tested in water. Find the corresponding pressure drop in prototype. Take Pair = $1.24kg/m^3$ viscosity of water = 0.01 poise and viscosity of air = 0.00018 Poise. **(06 Marks)**

Module-4

7 a. Explain Boundary layer concept and derive the relation for Displacement thickness. **(08 Marks)**

b. Find the Diameter of parachute with which man weight 80kg descends to the ground from an aircraft against a resistance of air with a velocity of 25m/s. Take C_d = 0.5, Pair = $1.25kg/m^3$. **(04 Marks)**

c. Calculate the co-efficient of lift and drag for a kite having 60cm × 60cm weighing 2.943N assume an angle of 10° to the horizontal. If the pull on the string is 29.43N and 45° to horizontal when the wind is flowing at 40km/hr. Take Pair = $1.25kg/m^3$. **(08 Marks)**

OR

8 a. Derive the relation for Drag force on a flat plate due to Boundary layer and write its applications. **(08 Marks)**

b. Explain Kutta – Joukowsky theorem with sketch and write the methods for preventing boundary layer separation. **(08 Marks)**

c. Find the Displacement thickness, Energy thickness and Momentum thickness for velocity distribution in Boundary layer as $\left[\frac{u}{U}=\frac{y}{\delta}\right]$ also calculate δ^*/θ **(04 Marks)**

Module-5

9 a. Explain the concept of propagation of pressure wave and Mach cone. With sketch explain the zone of action and zone of silence. **(08 Marks)**

b. A gas with a velocity of 350m/s is flowing through a horizontal pipe at a section where pressure is $8N/cm^2$ (absolute) and 30°C temperature. The pipe changes in diameter and at this section the pressure is $12N/m^2$ (absolute). Find the velocity of gas at this section if flow is adiabatic. Take R = 287 J/kg-K, K = 1.4. **(08 Marks)**

c. Define Mach number and differentiate the flow and explain Mach number Regions. **(04 Marks)**

OR

10 a. Derive the expression for velocity of sound wave in a fluid. Also write the expression for velocity of sound for Adiabatic process. **(08 Marks)**

b. Define stagnation pressure, Temperature and Density. Also derive the relation for stagnation pressure ratio in terms of mach number. **(06 Marks)**

c. Find the Mach number of an aeroplane when it is flying at 900km/hr through air having pressure of $8N/cm^2$ and temperature −15°C. Take K = 1.4 and R = 287J/Kg-K. Also calculate pressure, temperature and density of air at stagnation point on the nose of the plane. **(06 Marks)**

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