Exam.Code:0940
Sub. Code: 7051

1058

B.E. (Mechanical Engineering)
Fourth Semester
MEC-406: Fluid Mechanics

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I (Section-A) which is compulsory and selecting two questions each from Section B.C.*

x-x-x

Section – A (2 marks each)

1. Explain the concept of Hydrostatic Paradox?
2. What are Shock Waves and for what purpose Wind Tunnels are used?
3. Differentiate between Eulerian and Lagrangian method of representing fluid motion
4. Define a Weir. State the difference between a Notch and Weir
5. What do you understand by Boundary layer and what are the methods used to arrest or delay the flow separation

Section – B

6. a) A piston of dimensions, **10 cm** diameter and **12.5 cm** length slides vertically down in a cylinder of diameter **10.05 cm**. The oil filling the clearance space between the piston and cylinder has a viscosity of **0.60 Poise.** Find the speed with which the piston slides down if the load on the piston is **20 N.**

   b) A circular plate of **2 m diameter** is submerged in water, with its greatest and least depth below the water surface being **2 m** and **1 m** respectively. Determine: (a) The total pressure on the face of the plate (b) The position of centre of pressure. (5, 5)

7. a) A **40 cm** diameter pipe carries water under a head of **15 metre** with a velocity of **5.5 m/s**. If the axis of the pipe turns though **45°**, find the magnitude and direction of the resultant force on the bend.

   b) The velocity component in a two dimensional flows are:

$$u = \frac{y^3}{3} + 2x - x^2y \text{ and } v = xy^2 - 2y - \frac{x^3}{3}$$

   (a) Is the Flow possible? If so, obtain an expression for the Stream Function (b) Is the Flow Ir-Rotational? If so, obtain an expression for the Velocity Potential. (5, 5)

8. Derive the Euler's equation in Cartesian coordinates and then proceed to derive the Bernoulli's equation. Also list down the assumptions used.

P.T.O.

Section – C

9. (a) Find out the Displacement Thickness and Momentum Thickness in terms of nominal boundary layer thickness δ in respect of the following velocity profile in the boundary layer on a flat plate:

(i) $\frac{u}{U_o} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$ (ii) $\frac{u}{U_o} = \left(\frac{y}{\delta}\right)^{1/m}$

where "**u**" is the velocity at a height "**y**" above the surface and "U_o" is the free stream velocity.

b) What is a Rankine Half- Body and explain the flow past a Rankine Half- Body with the help of suitable labeled diagrams and corresponding equations. (5, 5)

10. a) Show that the discharge per unit width between two parallel plates distance "**b**" apart, when one plate is moving at velocity "**V**" while the other one is held stationery, for the condition of zero shear stress at the fixed plate is: **q=bV/3**

b) A fluid of viscosity **0.7 Ns/m²** and specific gravity **1.3** is flowing through a circular pipe of diameter **100 mm**. The maximum shear stress at the pipe wall is given as **196.2 N/m²**. Find (i) the pressure gradient (ii) the average velocity (iii) Reynolds number of flow. (4, 6)

11. (a) A source of disturbance travels in air alternatively at Subsonic, Sonic and Supersonic velocities. Sketch and explain the propagation of disturbance in each of the above cases.

(b) Determine the speed of sound in air at (a) **300 K** and (b) **1000 K**. Also determine the Mach number of an aircraft moving in air at a velocity of **240 m/s** for both cases. **R =0.287 kJ/kg · K and γ = 1.4.** (6, 4)

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