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15ME44

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018

**Fluid Mechanics**

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing one full question from each module.****Module-1**

- 1 a. Define the following properties of fluid with their units :  
 i) Mass density ii) Dynamic viscosity iii) Surface tension (06 Marks)
- b. Determine the specific gravity of a fluid having a kinematic viscosity of the 0.04 stoke and dynamic viscosity of 0.05 poise. (04 Marks)
- c. An oil film of thickness 1.5mm is used for lubricating between a square plate of size  $0.8\text{m} \times 0.8\text{m}$  and an inclined plane having an inclination of  $30^\circ$  with the horizontal. The weight of the square plate is 300N and slides down the plane with a uniform velocity of 0.3m/s. Find the dynamic viscosity of oil. (06 Marks)

**OR**

- 2 a. Define : i) Bouyancy ii) Meta centre. (02 Marks)
- b. Derive an expression for total pressure force and depth of centre of pressure for a vertical surface submerged in water. (08 Marks)
- c. A solid cylinder of diameter 4m has a height of 3m. Find the meta centre height when it is floating in water with its axis vertical. The Specific gravity of cylinder is 0.6. (06 Marks)

**Module-2**

- 3 a. Explain the two different fluid flow analysis method with suitable example. (06 Marks)
- b. The velocity potential for 0 is given by  $\phi = -\frac{xy^3}{3} - x^2 + \frac{x^3y}{3} + y^2$   
 Calculate the velocity components in the X and Y direction. Check the possibility of such a flow. (10 Marks)

**OR**

- 4 a. Derive Euler's equation of motion for a steady flow and deduce Bernoulli's equation. (10 Marks)
- b. A horizontal venturimeter with inlet dia. 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet is  $17.658 \text{ N/cm}^2$  and Vacuum pressure at the throat is 30cm of mercury. Find the discharge of water through venturimeter  $C_d = 0.9$ . (06 Marks)

**Module-3**

- 5 a. Define Reynolds number. What is its significance? List the characteristic of laminar flow. (08 Marks)
- b. A crude oil of viscosity 0.97 per sec and specific gravity 0.9 is flowing through a horizontal circular pipe of diameter of 0.1m and length 10m. Calculate the difference of pressure at two ends of the pipe if 100kg is collected in a tank in 0.5 minutes. Assume laminar flow. (08 Marks)

**OR**

- 6 a. Derive the Darcy Weisbach equation. (08 Marks)
- b. A 10cm diameter pipe takes off abruptly from a large tank and runs 5m, then expands to 20cm diameter abruptly and runs 50m and next discharges directly to open air with a velocity of 25m/s. Calculate the height of water surface above point of discharge. Take Darcy's coefficient 0.0065. (08 Marks)

**Module-4**

- 7 a. Define :  
 i) Displacement thickness  
 ii) Momentum thickness  
 iii) Energy thickness  
 iv) Shape factor as with respect to boundary layer. (08 Marks)
- b. A man descends the ground from an aeroplane with help of a parachute, which is hemispherical having a diameter of 5m against the resist of air with a uniform velocity of 25m/s. Find the weight of the man if the weight of parachute is 9.81,  $C_D = 0.6$ . (08 Marks)

**OR**

- 8 a. Explain the different types of similitude. (08 Marks)
- b. Assume the viscous force  $F$  exerted by a fluid on sphere of diameter  $D$ , depends on viscosity  $\mu$  of mass density  $\rho$  and velocity of motion of the sphere, obtain the expression for shear force  $F$ , using Buckingham's  $\pi$  - theorem method. (08 Marks)

**Module-5**

- 9 a. Define: i) Mach line ii) Mach angle iii) Subsonic and supersonic flow. (08 Marks)
- b. Calculate the velocity and Mach number of a supersonic aircraft flying at an altitude of 1200m when temperature is 300K. Sound of aircraft is heard 2 seconds after passage of aircraft over the head of an observer. Take  $r = 1.41$ ,  $R = 287 \text{ J/kg/k}$ . (08 Marks)

**OR**

- 10 a. Write short essay on the engineering application of CFD, bringing the advantages and the limitations. (08 Marks)
- b. Define the following terms and write the relevant equations for the same : -  
 i) Stagnation Temperature  
 ii) Stagnation Pressure. (08 Marks)

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