

# CBCS Scheme



15ME44

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**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

- Define the following properties of fluid with their units :  
i) Mass density    ii) Dynamic viscosity    iii) Surface tension    (06 Marks)
  - 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)
  - An oil film of thickness 115mm is used for used for lubricating between a square plate of size 0.8m × 0.8m and an inclined plane having an exclination of 30° 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

- Define : i) Bouyancy    ii) Meta centre.    (02 Marks)
  - Derive an expression for total pressure force and depth of centre of pressure for a vertical surface submerged in water.    (08 Marks)
  - 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

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

OR

- Derive Euler's equation of motion for a steady flow and deduce Bernoullis equation.    (10 Marks)
  - A horizontal venturimeter with inlet dia. 20cm and throat diameter 10cms is used to measure the flow of water. The pressure at inlet is 17.658 N/cm<sup>2</sup> and Vaccum pressure at the throat is 30cms of mercury. Find the discharge of water through venture meter  $C_d = 0.9$ .    (06 Marks)

### Module-3

- Define Reynolds number. What is its significance? List the characteristic of laminar flow.    (08 Marks)
  - 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

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



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**Module-4**

- 7 a. Define :
- Displacement thickness
  - Momentum thickness
  - Energy thickness
  - Shape factor as with respect to boundary layer. (08 Marks)
- b. A man descends the ground from an airoplane 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,  $CD = 0.6$ . (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  $r = 1.41$ ,  $R = 287$  J/kg/k. (08 Marks)

**OR**

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

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