B.E. (Civil Engineering) Fifth Semester (C.B.S.)

# Fluid Mechanics - I

P. Pages : 2 **NRT/KS/19/3405**

Time : Three Hours * 0 1 2 4 * Max. Marks : 80

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Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.

**1.** a) State Newton's law of viscosity and draw a Rhelogical diagram and show theorem. **7**

1) Ideal Fluid. 2) Non-Newtonian Fluid.
3) Newtonian Fluid. 4) Real Fluid.
5) Ideal Fluid.

b) A body weighing 350N with a flat surface area of $0.065m^2$ slides down a lubricated inclined plane making a angle $35^o$ with the horizontal for the viscosity of 0.1 Pa-S and body speed of 4m/sec. Determine the lubricant film thickness. **7**

**OR**

**2.** a) A piston 800mm diameter and 300mm long works in a 900mm diameter cylinder. If the annular space is filled with a lubricating oil of viscosity 0.6 poise, calculate the speed of piston in vertical position. The axial load including the weight of the piston is 9.81N. **7**

b) Find surface tension in a soap bubble of 25mm diameter when the inside pressure is $1.7N/m^2$ above atmosphere. Derive the expression used for the surface tension. **7**

**3.** a) Prove that the total pressure exerted by a static liquid on an inclined plane submerged surface is same as the force exerted on a vertical plane surface as long as the depth of centre of gravity of the surface is unaltered. **7**

b) A circular plate of diameter 3m is submerged in water vertically such that its top surface is 1.5m below the free surface of the water. Determine the total pressure force on the plate and the position of the centre of pressure. **6**

**OR**

**4.** a) Discuss metacenter and metacentric height of a floating body. State the position of metacenter, centre of gravity. **6**

b) An ice-berg floats in sea water. If the specific gravity of ice berg and sea water are 0.90 and 1.30, respectively. Find the percentage of total volume of the ice berg below the sea water surface. **7**

**5.** a) Define stream function and velocity potential show that equipotential and stream line intersects each other orthogonally. **6**

b) If $\phi = x(4y-1)$, determine the velocity at point (5, 6) and (6, 7) also find stream functions. **7**

**OR**

**6.** a) $v\left(6xt+y^2z+15\right)i+\left(3xy^2+t^2y\right)j+\left(2+3ty\right)k$ what is the acceleration of a particle at (3, 2, 4) at time t = 3sec. Classify this velocity field as steady or unsteady, uniform or non-uniform and one, two and three dimensional? **6**

b) If $\psi=\left(x^3-y^3\right)$, show that the flow is not a potential flow. **7**

**7.** a) Bernoullis theorem is based on which principle? Give its statement. Name three devices where Bernoullis equation is practically applied. **5**

b) A 400m long pipe has a slope of 1:150 and tapers from 1.25m diameter at higher end to 0.60m diameter at the lower end. It carries water at a rate of 150 lit/sec. Find the average velocities at the higher and lower end. If the pressure at higher end is 200 kN/m$^2$. Find the pressure at the lower end. Neglect friction. **8**

**OR**

**8.** a) Coefficient of discharge of venturimeter is always greater than orificemeter. Why? **5**

b) A venturimeter with inlet and throat of 150mm and 75mm resp. is mounted in a vertical pipe carrying water, the flow being upward. The throat section is 250mm above the inlet of the vencutirmeter. The discharge of the venturimeter is 40 lt/sec. and coefficient of discharge is 0.96. Calculate **8**

a) The static pressure difference between inlet & throat.
b) Difference in the level of mercury in tube.

**9.** a) An orifice of diameter 40mm is provided in a vertical cylindrical tank of radius 550mm and length 2000mm. Find the discharge through the orifice. Take Cd = 0.63. **7**

b) A vertical cylindrical tank of diameter 850mm and length 2500mm is provided with an orifice of diameter 110mm. Find the time taken to reduce the head of water from 1500mm to 600mm. Cd = 0.63. **6**

**OR**

**10.** a) Determine the discharge through a rectangular notch of length 2m with the head over the notch as 0.5m. Determine the discharge through the notch considering velocity of approach. Cd = 0.64. **7**

b) A weir 36m long is divided into 12 equal bays by vertical posts, each 60cm wide. Determine the discharge over the weir if the head over the crest is 1.2m and velocity of approach is 2m/s. **6**

**11.** a) What are repeating variables? How to select these? **6**

b) The size of droplets 'd' produced by a liquid spray nozzle depends upon the nozzle diameter 'D', jet velocity 'V' liquid density ($\rho$) and viscosity '$\mu$' and surface tension '$\sigma$' using Buckingham's pi theorem, obtain the dimensionless parameter. **8**

**OR**

**12.** a) Explain Raynolds experiment. List out the observations made by Raynolds. **8**

b) Differentiate between laminar and turbulent flow. **6**

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