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

Fluid Mechanics - I

P. Pages : 2 **KNT/KW/16/7320**

Time : Three Hours Max. Marks : 80

* 0 6 4 1 *

Notes :
1. All questions carry marks as indicated.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers whenever necessary with the help of neat sketches.
5. Use of non programmable calculator is permitted.

1. a) State Newton's law of viscosity and Draw a Rheological diagram and show thereon: **7**

i) Ideal fluid ii) Non-Newtonian fluid

iii) Thixotropic Fluid iv) Ideal plastic

v) Dilatent fluid vi) Ideal solid

b) A body weighing 310 N with a flat surface area of 0.055 m^2 slides down a lubricated inclined plane making a angle 25^0 with the horizontal for the viscosity of 0.1 Pa-S and body speed of 2 m/sec. Determine the lubricant film thickness. **7**

OR

2. a) A Piston 797 mm diameter and 200 mm long works in a 800 mm diameter cylinder. If the annular space is filled with a lubricating oil of viscosity 0.5 poise, calculate the speed of piston in vertical position. The axial load including the weight of the piston is 9.81 N. **7**

b) Find surface tension in a soap bubble of 20 mm diameter when the inside pressure is 1.5 N/m^2 above atmosphere. Derive the expression used for the surface tension. **7**

3. a) Convert a pressure head of 10 m of water into **6**

i) Pressure head of carbon tetrachloride of specific gravity 1.6

ii) Pressure head of oil of specific gravity 0.8

iii) Pressure head of mercury.

b) A vertical square plate of size 1 m x 1 m is immersed in water such that its side is parallel to water surface and lies 0.5 m below it. Calculate the magnitude of total pressure and centre of pressure. **7**

OR

4. a) An open rectangular tank 3.5 m long x 2 m deep x 1.8 m wide contains water to a depth of 1.5 m. Find the horizontal acceleration which may be imparted to the tank along its longer side so that there is no spilling of water from the tank. **6**

b) A rectangular barge is 20 m long, 6 m wide and 3 m deep. When fully loaded, the depth of immersion of the barge is 2 m. The CG of the barge is on the axis of symmetry at the water surface. Determine the stability conditions of the barge & metacentric height. **7**

5. a) Define stream function and velocity potential. Show that equipotential and streamlines intersect each other orthogonally. **6**

b) If $\varphi = x(2y-1)$, determine the velocity at points (4,5) and (5,6) Also find stream function. **7**

OR

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

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

7. a) Explain. **6**

i) Pitot tube ii) Orificemeter

b) A venturimeter with 150 mm inlet diameter & 100 mm throat is used for measuring flow. of oil (S=0.9). Differential gauge shows a reading of 30 cm. Assuming C_d of 0.98, calculate the discharge flowing through the venturimeter. **7**

OR

8. a) Explain Briefly: **6**

i) Impulse Momentum equation for fluid flow.

ii) Kinetic energy correction factor.

b) Derive Bernoulli's theorem from Eulers' equation of motion. A horizontal water pipe of diameter 15 cm converges to 7.5 cm diameter. If the pressure at the two sections are 400 kPa and 150 kPa respectively, calculate the flow rate of water. **7**

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

b) A vertical cylindrical tank o f diameter 800mm & length 2000mm is provided with an orifice of diameter 110mm. Find the time taken to reduce the head of water from 1500mm to 500mm. Take C_d=0.63 **7**

OR

10. a) Determine the discharge through a rectangular notch of length. 2.1 m with the head over the notch as 0.5 m. Determine the discharge through the notch considering velocity of approach. C_d = 0.64. **7**

b) A weir 36 m long is divided into 12 equal bays by vertical posts, each 60 cm wide. Determine the discharge over the weir if the head over the crest is 1.2 m and velocity of approach is 2 m/s. **7**

11. a) Explain briefly. **6**

1) Laminar and Turbulent flow.

2) Reynold's number and critical velocity.

b) What size of pipe should be installed to carry 5.5 x 10^{-3} m^3/s fo medium oil (Kinematic viscosity 6 x 10^{-6} m^2) under laminar flow conditions? **7**

OR

12. a) Explain Buckingham - π theorem. **6**

b) Resistance R due to wind on a tall vertical chimney is dependent upon the density ρ and viscosity σ of air, the wind velocity V, the diameter D and height H of the chimney. Develop an expression for resistance of the chimney in terms of these quantities. **7**

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