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

Fluid Mechanics - I

P. Pages : 3 | **NKT/KS/17/7320**

Time : Three Hours | 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) Define: **4**

i) Newtonian and Non-Newtonian fluid with one example each

ii) Dynamic viscosity and kinematic viscosity.

b) Determine specific gravity of a fluid having density $3000 kg/m^3$. Also find its kinematic viscosity when at a certain point in the fluid, the shear stress is $0.75 N/m^2$ and velocity gradient is 0.9/sec. **4**

c) A capillary tube having internal diameter 6mm is immersed in a water at 20ºC. Calculate the height of water rise in the capillary. Take angle of contact as $\alpha = 60^\circ$ and surface tension of water in contact with air as 0.073 N/m. **5**

OR

2. a) Differentiate between : **6**

i) Pressure intensity and pressure head.

ii) Simple manometer and differential manometer.

iii) Gauge pressure and absolute pressure.

b) A pipe contains an oil of specific gravity 0.9. A differential manometer corrected at the two points A and B on same level shows a difference in mercury level as 150mm. Determine the difference of pressure at the two points in bar. **7**

3. a) What is the effect of increase in liquid level on centre of pressure, when the plane surface is immersed in liquid **6**

i) Vertically

ii) Horizontally?

b) A rectangular tank is accelerated horizontally at $2\,m/sec^2$ in the direction of its length. The tank is 3m long; 1.5m wide and 1.5m deep and contains water to a depth of 0.8m. Find **7**

i) the inclination of water surface with the horizontal.
ii) Depths of water at the two ends.
iii) Total pressure on the two ends of the tank.

OR

4. a) Explain how would you check the experimentally stability of floating bodies? Also what are the three states of equilibrium. **6**

b) A wooden block of specific gravity 0.75 floats in water. If the size of the block is 1m x 0.5m x 0.4m, Find its metacentric height. **7**

5. a) Differentiate between the Eulerian and Lagrangian methods of representing fluid flow. **6**

b) A two dimensional flow is described by the velocity components **7**

$u = 5x^3$ and $v = -15x^2y$

Determine the stream function, velocity and acceleration at point p (x=1m and y=2m).

OR

6. a) Define: **6**

i) Stream line.
ii) Flow net
iii) Irrotational flow
iv) Vorticity
v) Velocity potential
vi) Unsteady and steady flow.

b) In a two dimensional flow field for an incompressible fluid the velocity components are $u = \frac{y^3}{3} + 2x - x^2y$ and $v = xy^2 - 2y - \frac{x^3}{3}$. Find the expression for the stream function Ψ and velocity potential ϕ. **7**

7. a) Write the assumptions made while deriving Bernoulli's equation. Also state and prove Bernoulli's equation. **7**

b) A pipe 200m long slopes dow at 1 in 100 and tapers from 600mm diameter at the higher end to 300mm diameter at the lower end. The pipe carries 100 litres/sec of oil (Sp. gr. 0.85). If the pressure gauge at the higher end reads $50\,kN/m^2$, determine **7**

i) Velocities at the two ends, and
ii) Pressure at the higher end

Neglect losses.

OR

8. a) An orifice of 150mm diameter is fitted in a pipe having diameter of 300mm carrying oil of Sp. gravity. 0.9. Reading of differential manometer attached to the pipe shows a reading of 500mm of mercury. If the coefficient of discharge of the meter is 0.64, determine the rate of flow. **7**

b) A venturimeter is used for measuring the flow of petrol in a pipeline inclined at 35º to horizontal. The Sp. gr. of petrol is 0.81 and throat area ratio is 4. If the difference in mercury level in the gauge is 50mm **7**

Calculate the flow in m^3/s, if the pipe diameter is 300mm. Take venturimeter constant = 0.975.

9. a) An orifice 65mm diameter is discharging water under a head of 8m. If coefficient of discharge is 0.6 and coefficient of velocity is 0.9, find actual discharge and also the actual velocity of the jet at vena contracta. **7**

b) Find the discharge from a 100mm diameter external mouthpiece, fitted to a side of a vessel, if the head over the mouthpiece is 4m. **7**

OR

10. a) Find the discharge over a rectangular weir of length 100m. The head of water over the weir is 1.5m. The velocity of approach is given as 0.5 m/s. Assume coefficient of discharge as 0.6. **7**

b) Find the discharge over a triangular notch of angle 60º, when the head over the v-notch is 0.3m. Take coefficient of discharge as 0.62. **7**

11. a) Oil of absolute viscosity 1.5 poise and density 848.3 kg/m^3 flows through a 300mm diameter pipe. If the average velocity of the flow is 1.04 m/s, determine the Reynold's number and state the type of flow. **7**

b) Define: **6**

i) Reynold's number.
ii) Turbulent flow.
iii) Critical velocity.
iv) Viscous flow.

OR

12. a) Define the following dimensionless numbers and state their significance for fluid flow problems: **6**

i) Froude Number
ii) Euler number.
iii) Mach number.

b) What are the various methods of dimensional analysis to obtain a functional relationship between various parameters influencing a physical phenomenon? Explain any one of them. **7**

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