B.E. (Mechanical Engineering / Power Engineering (New)) Third Semester (C.B.S.)

Fluid Mechanics Paper - III

P. Pages : 3 **TKN/KS/16/7317/7343**

Time : Three Hours * 0 9 2 8 * Max. Marks : 80

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. Assume suitable data whenever necessary.
9. Use of non programmable calculator is permitted.

1. a) Explain the following terms briefly. **6**

i) Viscosity. ii) Compressibility.

iii) Capillarity.

b) The velocity distribution of flow over a plate is parabolic with vertex 30cm from the plate, where the velocity is 180 cm/s. The viscosity of the fluid is 0.9 N-s/m^2. Find the velocity gradients and Shear stresses at a distances of 0,15 cm and 30cm from the plate. **7**

OR

2. a) State and derive continuity equation in Cartesian coordinate form. **6**

b) For a two dimensional flow the velocity function is given by the expression, $\phi = x^2 - y^2$ **7**

i) Determine velocity components in x and y directions.

ii) Show that the velocity components satisfy the conditions of flow continuity.

iii) Determine stream function and the flow rate between the streamlines (2,0) and (2,2).

iv) Show that the streamlines and potential lines intersect orthogonally at the point (2,2).

3. a) State and derive "Hydrostatic Law" with neat sketch. **6**

b) A U-tube Manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipe line. Its left end is connected to the pipe and the right limb is open to the atmosphere. The centre of the pipe is 100mm below the level of Mercury (SP. Gravity =13.6) in the right limb. If the difference of Mercury level in the two limbs is 160mm, determine the absolute pressure of the oil in the pipe, if atmospheric pressure is 100 kN/m^2 . **7**

OR

4. a) A 1m wide and 1.5m deep rectangular plane surface lies in water in such a way that its plane makes an angle of 30º with the free water surface. Determine the total pressure and position of center of pressure when the upper edge is 0.75m below the free water surface. **6**

b) A cylindrical buoy is 2m in diameter, 2.5m long and weighs 2.2 metric tons. The density of sea water is 1025 kg/m^3. Show that the body can not float with its axis vertical. **7**

5. a) Derive the expression for Bernoulli's equation with Euler's equation of motion with neat sketch. **6**

b) A pipe line carrying oil of specific gravity 0.8 changes in diameter from 300mm of position 1 to 600mm at position 2 which is 5m at a higher level. If the pressure of position 1 and 2 are 100 KN/m^2 and 60 KN/m^2 respectively, and the discharge is 300 litre/s, determine. **8**

i) Loss of head and

ii) Direction of flow.

OR

6. a) Find the discharge of water flowing through a pipe 30cm diameter placed in a inclined position where a venturimeter is inserted, having a throat diameter of 15cm. The difference of pressure between the main and throat is measured by a liquid of specific gravity 0.6 in an inverted U-tube which gives a reading of 30cm. The loss of head between the main and throat is 0.2 times the kinetic head of the pipe. **7**

b) An orifice meter with orifice diameter 15cm is inserted in a pipe of 30cm diameter. The pressure difference measured by mercury oil differential manometer on the two sides of the orifice meter gives a readings of 50cm of mercury. **7**
Find the rate of flow of oil of sp. gravity 0.9 when the cd = 0.64.

7. a) Derive Darcy-Weisbach equation, for major losses in pipe. **6**

b) A fluid of viscosity 0.7 NS/m^2-and specific gravity 1.3 is flowing through a circular pipe of diameter 100mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2, find. **7**
i) The pressure gradient.
ii) The average velocity and
iii) Reynolds number of the flow.

OR

8. a) Starting from first principle show that for laminar flow through pipe, the velocity profile is parabolic. **6**

b) The pressure drop ΔP generated by a pump of a given geometry is known to depend upon the impeller diameter D, the rotational speed N, the fluid discharge Q, the fluid density ρ and viscosity μ. Obtain the dimensionless form of the functional relationship. **7**

9. a) A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250mm. The pressure intensities in the large and smaller pipe is given as 13.73 N/cm^2 and 11.77 N/cm^2 respectively. Find the loss of head due to contraction if coefficient of contraction is 0.62. Also determine the rate of flow of water. **6**

b) A pipeline ABC is 300m long and is laid on an upward slope of 1 in 50. The portion AB is 150m long and 120mm in diameter. At B the diameter suddenly enlarges to 240mm and remains so for the rest of the length BC of the pipe. At the lower end, 300 litre of water per second is pumped into the pipe under a pressures of 300 KN/m^2 which is discharged at the upper end into a closed tank. Assuming a coefficient of friction of 0.08, determine the pressure at point C. Also draw the energy gradient and hydraulic gradient lines. **7**

OR

10. a) Derive the expression for power transmission through pipe. **6**

b) Total 50 litre /second of water is pumped through two pipes in parallel of 15cm diameter and other pipe is 10cm in diameter, both pipes being 1500m long, calculate the flow rate through each pipe and power of the pump. Friction factor is 0.02. **7**

11. a) **7**

The velocity distribution in the boundary layer is given by $\frac{u}{U} = \frac{3}{2}\frac{y}{\delta} - \frac{1}{2}\frac{y^2}{\delta^2}$

δ being boundary layer thickness. Calculate the following.

i) The ratio of displacement thickness to boundary layer thickness.

ii) The ratio of momentum thickness to boundary layer thickness.

b) A circular kite of diameter 1.38m and thickness 10cm is hold by a cord and flies at an angle of 60º to the horizontal when wind velocity is 30 km/hr and blows horizontally, the angle of cord to the horizontal is 60º and kite floats at right angle to the cord. If the mass of kite is 510gm and tension in cord holding the kite is 26.2KN. calculate drag and lift coefficients and forces. **7**

OR

12. Write short notes on **any three.** **14**

i) Streamlines and Bluff bodies.

ii) Boundary layer Separation.

iii) Turbulent flow and velocity distribution.

iv) Flow around circular cylinder and Aerofoil.

v) Drag and lift.

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