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

Fluid Mechanics - I

P. Pages : 3 **TKN/KS/16/7408**

Time : Three Hours Max. Marks : 80

Notes : 1. All questions carry marks as indicated.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data whenever 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 laws of viscosity. How viscosity will be find out? **4**

b) Explain : **4**
i) Compressibility. ii) Capillary action.

c) Ten litres of a liquid of specific gravity 1.30 is mixed with a 6 litres of a liquid of specific gravity 0.80. If the bulk of the liquid shrinks by 1.5% on mixing, calculate the fluid properties. **5**

OR

2. a) Differentiate between: **6**
i) Newtonian fluid and Non Newtonian fluid.
ii) Cohesion and adhesion.
iii) Dynamic viscosity & Kinematic viscosity.

b) A rectangular solid block of 1m x 1m that weights 30 N slides down a 30º inclined plane. The plane is lubricated by a 5mm thick film of oil of viscosity of $0.04\,\mathrm{N-S/m^2}$. Calculate the terminal velocity of the block. **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. **6**

b) A circular plate of diameter 2 m is submerged in water vertically such that its top surface is 1 m below the free surface of the water. Determine the total pressure force on the plate and the position of the centre of pressure. **7**

OR

4. a) Discuss metacenter and meta centric 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 iceberg and sea water are 0.90 and 1.03, respectively, find the percentage of total volume of the iceberg below the sea water surface. **7**

5. a) What does the smoke emitting from a lighted cigarette represent, streamline or path line or streak line? Why? **4**

b) How is the circulation defined? **4**

c) Show that the lines of constant stream function and velocity potential must intersect orthogonally. **6**

OR

6. a) Explain the following terms in brief: **4x2 =8**

i) Stream function

ii) Velocity potential

iii) Flow nel.

iv) Vorticity.

b) A two dimensional flow field has velocities along the x-direction and y directions given by $u = x^2 t$ and $v = -2xyt$ respectively, where t is time. Find the equation of streamline. **6**

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

b) A 300 m long pipe has a slope of 1:100 and tapers from 1.20m diameter at higher end to 0.60m diameter at the lower end. It carries water at a rate of 100 lit/sec. Find the average velocities at the higher and lower end. If the pressure at high end is $150\,kN/m^2$, Find the pressure at the low end. Neglect friction. **8**

OR

8. a) Coefficient of discharge of venturimeter is always greater than orifice meter. 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 upwards. The throat section is 250 mm above the inlet of the venturimeter. The discharge of the venturimeter is 40 lit/sec. and coefficient of discharge is 0.96. Calculate **8**

a) The static pressure difference between inlet and throat and

b) The difference in levels of mercury in a vertical u-tube manometer connected between these points.

9. a) Derive the expression $C_d = C_c \times C_v$. **6**

b) A swimming pool 15m long and 8m wide holds water to a depth of 2 m. If the water is discharged through a 20cm diameter orifice at the bottom of pool, find the time required to empty the pool. The coefficient of discharge of the orifice is 0.63. **7**

OR

10. a) Explain : **6**

i) Cippoletti weir

ii) Velocity of approach.

iii) Error in rectangular weir.

b) In an experiment on a rectangular notch of 0.50m wide, the flow is collected in a 1.0m diameter vertical cylindrical tank. It is found that the depth of water increases by 0.75m in 20 seconds when the head over the notch is 0.10m. Determine the coefficient of discharge of the notch. **7**

11. a) Define and give significance of Reynold's number and Froude number. Explain both. **6**

b) The size of droplets 'd' produced by a liquid spray nozzle depends upon the nozzle diameter 'D', Jet velocity 'v', liquid density 'ρ' and viscosity 'μ', and surface tension 'σ' using Buckingham's π theorem, obtain the dimensionless parameters. **8**

OR

12. a) Explain Reynold's experiment. List out the observations made by Reynolds. **5**

b) Differentiate between laminar and Turbulent flow. **3**

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

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