S 9066

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Third Semester

Civil Engineering

CE 233 — FLUID MECHANICS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mention the phenomenon, which is responsible for capillary rise and fall.

2. Write the dimensions of the followings : dynamic viscosity and compressibility.

3. Write the mathematical relationship among types of pressures.

4. Define Center of Buoyancy and Meta center.

5. Define the term 'Velocity Potential'.

6. What is the expression for total acceleration in case of steady flow and uniform flow?

7. What is the use of Moody diagram?

8. Define boundary layer.

9. Two reservoirs are connected 200 mm, 300 mm and 150 mm diameter pipes of lengths 120 m, 80 m and 140 m respectively in series. Calculate the equivalent diameter.

10. What do you mean by the term dynamic similarity?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A tube containing mercury has its right hand limb open to atmosphere and the left limb connected to a pipe conveying water under pressure, the difference in levels of mercury in the two limbs being 200 mm. If the mercury level in the left limb is 400 mm below the centre line of the pipe, find the absolute pressure in the pipe line. Also find the new difference in levels of mercury in the U-tube, if the pressure in the pipe falls by 2 KPa. (10)

(ii) A block of wood floats in water with 50 mm projecting above the water surface. When placed in glycerin of relative density 1.35, the block projects 75 mm above the liquid surface. Determine the relative density of the wood. (6)

Or

(b) A gate of 3 m wide divides a storage tank. On the one side petrol of specific gravity 0.78 is stored to a depth of 1.8 m while on the other side is oil of specific gravity 0.88 to a depth of 0.9 m. Determine the resultant pressure on the gate and the position at which it acts. (16)

12. (a) (i) Explain the various methods of velocity measurements. (8)

(ii) Briefly explain the various type of fluid flow. (8)

Or

(b) (i) A three dimensional velocity field is given by $u = xy^2t$; $v = (1/3)(y^3 t^3)$; and $w = (1/2)\ (xyz^2\ t^2)$. Determine the components of acceleration at (1, 2, 3) and t = 1 sec. (8)

(ii) A steady flow field of an ideal incompressible fluid is characterized by the stream function $\Psi = x^3y - xy^3$. Obtain its velocity potential function at (3, 2). (8)

13. (a) Derive the expression for Euler's equation for a steady incompressible fluid flow. From which derive the expression for Bernoulli's equation between two sections considering the loss of head. (16)

Or

(b) A 500 mm diameter vertical venturimeter discharges water through a throat of 250 mm diameter. The pressure difference measured by a inverted U-tube manometer. The vertical distance between inlet and throat section is 500 mm. Take C_d as unity. Determine the difference in pressure between these two sections when the discharge through the meter is 600 litres/sec ; and the manometer deflection 'x' as if the inverted U contains air. Take $\rho_{air} = 1.2$ kg/m^3. (16)

(a) (i) Derive the expression for loss of head due to sudden expansion. (8)

(ii) Briefly explain the various boundary layer thickness in a flat plate. (8)

Or

(b) (i) A pipe of 150 mm diameter is 14 m long and carries a discharge of 283 liters/s. Find the loss of head due to friction. Now the central 5 m length of pipe are replaced by a pipe of 230 mm diameter, the change of sections being sudden. What will be the saving in the loss of head due to the adoption of the alternative? Take $C_c = 0.62$ and $4f = 0.04$. (12)

(ii) Derive the expression for equivalent pipe diameter of a compound pipe. (4)

15. (a) Assuming that the resistance to motion, F of a body moving in a compressible fluid is a function of a characteristic dimension 'l' of the body, the velocity 'u' of the body and fluid properties density 'ρ', viscosity 'μ', and bulk modulus 'K'. Find the expression for F in terms of these quantities using Buckingham's Π-theorem. (16)

$$F = (1/2)(\rho u^2 l^2)\, \Phi \left[\rho u l/\mu, u/\sqrt{K/\rho}\right]$$

Or

(b) A 1/5th scale model of a torpedo is tested in a wind tunnel using air at 23 bars and 20°C, with a speed of 48 m/s and a viscosity of 184×10^{-6} poise. The resistance is found to be 76 N. Calculate the corresponding speed of full scale torpedo and the power required to drive it in sea water of density 1025 kg/m^3 of which the viscosity 164×10^{-4} poise.

Take for air R = 287 J/kg K. (16)