T 8084

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

Third Semester

Civil Engineering

CE 1202 — MECHANICS OF FLUIDS

(Common to B.E. (Part-Time) – Second Semester – Regulation 2005)

(Regulation 2004)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between ideal fluid and real fluid.

2. State Newton's law of viscosity.

3. Define metacentric height.

4. List the uses of flow nets.

5. State the assumptions made in the derivation of Bernoulli's equation.

6. Why is co-efficient of discharge of an orificemeter is less than that of venturimeter?

7. Define : Boundary layer thickness.

8. What are the conditions to be satisfied with regard to discharge and head loss in the case of pipes in series?

9. What is kinematic similarity?

10. What are the advantages of distorted models?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Distinguish between Newtonian and Non-Newtonian fluids. Give examples. (4)

(ii) In a pipe of diameter 30 cm, the velocity distribution is parabolic and is given as $u = ay^2 + by + c$ where u is the velocity in m/sec at distance of y metres from the boundary. The maximum flow velocity is 120 cm/sec. Calculate the shear stresses at y = 5 cm and 10 cm. Take the coefficient of dynamic viscosity of the fluid μ = 8.5 poise. (12)

Or

(b) (i) Show that the pressure inside a spherical liquid bubble is twice of that inside a liquid jet. (4)

(ii) The bulk modulus of elasticity of (1) water is 2.07 GPa and (2) air is 140 KPa. Determine the increase in pressure required to produce (A) one percent reduction in volume at the same temperature and (B) one percent reduction in volume of air undergoing isentropic compression. (12)

12. (a) (i) Prove that the centre of pressure is below the centre of gravity of a plane surface submerged in a liquid. (6)

(ii) The water level in a canal is regulated by a flat tipper gate inclined at 60° to the bed. The tipping takes place about a fulcrum placed at a height of 1 m from the bed when the water level in the canal reaches a maximum value H. Determine H. (10)

Or

(b) (i) Derive the continuity equation for a three dimensional incompressible flow. (6)

(ii) The velocity components for a two dimensional incompressible flow are given by

$$u = 3x - 2y \text{ and } v = -3y - 2x$$

Show that the velocity potential exists. Determine the velocity potential function and stream function. (10)

13. (a) (i) Water is flowing through a tapering pipe having diameters 300 mm and 200 mm at sections 1 and 2 respectively. The discharge through the pipe is 400 lpm. The sections 1 and 2 are 10 m and 8 m above the datum respectively. Determine the pressure at section 2 if the pressure at section 1 is 400 kN/m^2. Assume there are no losses. (8)

(ii) An oil of specific gravity 0.9 is flowing through a pipe of 20 cm diameter. An orificemeter with 10 cm diameter is inserted in the pipe to measure discharge. A differential U-tube mercury manometer connected to the orifice meter gives a pressure difference of 30 cm of mercury. Take $C_d = 0.65$ for orifice meter. Find the discharge. (8)

Or

(b) (i) Derive Darcy-Weisbach formula for frictional loss in a pipe. (8)

(ii) What power is required per kilometer of a 8.0 cm pipe line to maintain a flow of 5.0 lps of castor oil having a dynamic viscosity of 9.8 Poise. Assume flow is laminar. (8)

14. (a) (i) Derive Von Karman Momentum integral equation. (8)

(ii) If the velocity profile in a laminar boundary layer is given by

$$\frac{u}{V} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

Calculate the displacement and momentum thicknesses. (8)

Or

(b) (i) A 30 cm diameter pipe of length 30 m is connected in series to a 20 cm diameter pipe of length 20 m and conveys water. Determine the equivalent length of pipe of diameter 25 cm assuming that the friction factor remains the same and minor losses are negligible. (8)

(ii) The diameter of pipe suddenly increased from 200 mm to 300 mm. The rate of flow is 0.25 m^3/sec and the pressure in the smaller pipe is 11.772 N/cm^2. Determine (1) head loss due to sudden enlargement (2) pressure intensity in the larger pipe. (8)

15. (a) (i) What is meant by dimensional homogenity? Explain. (4)

(ii) State and explain Buckingham π -theorem. (6)

(iii) The pressure difference Δp in a pipe of diameter D and length L due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using dimensional analysis, obtain an expression for Δp. (6)

Or

(b) It is desired to obtain dynamic similarity between a 30 cm diameter pipe carrying linseed oil at 0.5 m^3/sec and a 5 m diameter pipe carrying water. What should be the rate of flow of water in lps. If the pressure loss in the model is 196 N/m^2, what is the pressure loss in the prototype pipe. Take kinematic viscosities of linseed oil and water as 0.457 and 0.0113 stokes respectively. Take specific gravity of linseed oil as 0.82. (16)
