

D1-17
B2-18
C1-9
H2

E 064

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2009.

THIRD SEMESTER

CIVIL ENGINEERING

CE 1203 — MECHANICS OF FLUIDS

(REGULATIONS 2007)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State and express Newton's law of viscosity.
2. What is surface tension?
3. When mercury and other lighter liquids are used as manometric fluids in U-tube manometers?
4. How fluid flows are classified?
5. State and express Bernoulli's theorem.
6. What is momentum principle?
7. What is displacement thickness in boundary layer flow?
8. List the various minor losses encountered in flow through pipes.
9. Distinguish dimensionally homogeneous equation from empirical equations – Give examples.
10. What are the three types of similarity?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Ten litres of a liquid of specific gravity 1.3 is mixed with 6 litres of liquid of specific gravity 0.8. If the volume of the liquid shrinks by 1.5% on mixing, calculate the specific gravity, density, volume and weight of the mixture. (10)
- (ii) Explain the property of compressibility of a fluid. (6)

Or

- (b) A square surface $3\text{ m} \times 3\text{ m}$ lies in a vertical plane. Determine the position of the centre of pressure and the total force on the square plate, when its upper edge is
- in water surface
 - 15 m below the water surface.
12. (a) Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches. Branch CD is 0.8 m diameter and carries one third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and diameter of CE.

Or

- (b) (i) Explain stream function and potential function in fluid motion. (8)
(ii) Explain how velocity measurement is done using different devices. (8)
13. (a) A $30\text{ cm} \times 15\text{ cm}$ venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm. Calculate
- Discharge of the oil
 - The pressure difference between the entrance section and the throat section. Take $C_d = 0.98$.

Or

- (b) An oil of viscosity 0.1 NS/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 5 cm and length 300 m. The rate of flow of fluid through the pipe is 3.5 l/s. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall.
14. (a) (i) Explain laminar boundary layer, laminar sub-layer and turbulent boundary layer. (8)
(ii) What do you mean by separation of boundary layer? What is the effect of pressure gradient on boundary layer separation? (8)

Or

- (b) The rate of flow of water through a horizontal pipe is $0.25\text{ m}^3/\text{s}$. The diameter of the pipe which is 20 cm suddenly enlarged to 40 cm. The pressure intensity in the smaller pipe is 0.10 N/mm^2 . Determine
- Loss of head due to sudden enlargement
 - Pressure in larger pipe
 - Power lost due to enlargement.

15. (a) Prove by Buckingham's π -theorem, the frictional torque T of a disc of diameter 'D' rotating at a speed 'N' in a fluid of viscosity ' μ ' and density ' ρ ' in a turbulent flow is given by

$$T = D^5 \cdot N^2 \cdot \rho \cdot \phi \left[\frac{\mu}{D^2 N \rho} \right]$$

Or

- (b) (i) What are the dimensionless numbers? Discuss the important dimensionless numbers used in model analysis. (8)
- (ii) What are the distorted models? Discuss on different scale ratios in distorted models. (8)