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B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Third Semester

Civil Engineering

CE 2202/080100015/10111 CE 305/CE 1203/CE 35 — MECHANICS OF FLUIDS

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Any missing data can be suitably assumed with proper justification.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Brief on bulk modulus.

2. Distinguish between vapour and gas.

3. With the help of a sketch, show the relationship between absolute pressure and gauge pressure.

4. Can there be flow across a streamline? Why?

5. Find the velocity of the flow of an oil through a pipe when the difference of mercury level in a differential U-Tube manometer connected to the two toppings of the pitot tube is 10cm. Take coefficient of pitot tube as 0.98 and specific gravity of oil = 0.8.

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6. State the Hagen Poiseuille formula for finding the head loss in a pipe iine due to viscous flow.

7. Define momentum Thickness and Energy Thickness.

8. Define boundary layer.

9. Write a short note on distorted models.

10. List the similitude involved in the model analysis.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive expression for the pressure inside a droplet and a free jet. (6)

(ii) A small thin plane surface is pulled through the liquid filled Space between two large horizontal planes in the parallel direction Show that the force required will be minimum if the plate is located midway between the planes. (10)

Or

(b) (i) Derive the linear momentum equation using the Control volume approach. (6)

(ii) Derive an expression for the torque required to overcome the viscous resistance when a circular shaft of diameter 'D' rotating at 'N' rpm in a bearing with the clearnance 't' varying uniformly from 't_1' m at one end to 't_2' m at the other end. The distance between the ends is 'L' m. The oil has a Viscosity of μ. (10)

12. (a) (i) Match the following :

(1)	U-tube manometer	(A)	Moderately low pressures
(2)	Single tube manometers	(B)	Negative pressures
(3)	Inverted U— tube manometers	(C)	High pressures
(4)	U-tube differential manometer	(D)	Differences in pressure between two points (4)

(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 of H. Determine H. (8)

(iii) A piece of metal weighing 1.5 N in air is found to weigh 1.1 N when submerged in water. What is its volume and what is its specific gravity? (4)

Or

(b) (i) Differentiate between the following : (2 × 3 = 6)

(1) Steady flow and uniform flow

(2) Laminar flow and turbulent flow.

(ii) A three dimensional flow field is given by

$$V = 2x^2y\vec{i} + 3y^2z\vec{j} - \left(4xz + 3yz^2\right)\vec{k}.$$

Show that it is a case of possible steady, incompressible fluid flow. (4)

(iii) Explain a Pitot-Static tube with a sketch. How do you determine the flow velocity at any point using a Pitot-Static tube? (6)

13. (a) The following date related to an inclined venturimeter

Diameter of the pipe line = 400 mm

Inclination of the pipe line with the horizontal = 30°

Throat diameter = 200 mm

The distance between the inlet and throat of the meter = 600 mm

Sp. gravity of oil flowing through the pipe line = 0.70

Sp. gravity of heavy U-tube liquid = 13.6

Reading (deflection) of the differential manometer = 50 mm

Determine the rate of flow in the pipe line. (16)

Or

(b) Two parallel plates kept 100 mm apart have laminar flow of oil between them with a maximum velocity of 1.5m/sec. Calculate

(i) the discharge per metre width

(ii) The shear stress at the plates

(iii) The difference in pressure between two Points 20m apart

(iv) The velocity gradient at the plates and

(v) The velocity at 20 mm from the plate Assume viscosity of oil to be 24.5 Poise.

14. (a) An oil of viscosity 0.1 NS/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 5cm and of length 300 m. The rate of flow of fluid through the pipe is 3.5 liters/sec. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. (16)

Or

(b) At a sudden enlargement of water main from 240 mm to 480 mm diameter, the hydraulic gradient rises by 10 mm. Estimate the rate of flow. Draw the HGL for the system described. (16)

15. (a) Write short notes on :

(i) Raleigh's method. (6)

(ii) Scale effect in model study. (5)

(iii) Buckingham's Pi-theorem. (5)

Or

(b) An oil of specific gravity 0.91 and viscosity of 0.03 poise is to be transported at the rate of 3 m^3/s through a 1.3 m diameter pipe. Model tests were conducted on a 130 mm diameter pipe using water having viscosity of 0.01 poise. Find the velocity of flow and discharge in the model. (16)