(b) (i) The velocity profile in fully developed laminar flow in a pipe of diameter D is given by $u_0\left(1-\frac{4r^2}{D^2}\right)$, where r is the radial distance from the centre. If the viscosity of the fluid is μ, determine the pressure drop across a length L of the pipe. (10)

(ii) Water flows through a 30 cm diameter pipe and the flow causes a measured lost of head of 15 m in 350 m of pipe length. Calculate the shear stress at the walls and also find shear stress at 5 cm from the centreline of the pipe. (5)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 25046

B.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Third Semester

Civil Engineering

CE 8302 — FLUID MECHANICS

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Newton's Law of Viscosity.

2. Determine the specific gravity of a fluid having viscosity 0.05 poise and kinematic viscosity 0.035 stokes.

3. Write the integral form of the momentum equation.

4. What is Euler's equation of motion?

5. What are fundamental dimensions?

6. Define dimensional homogeneity.

7. What is Moody's chart?

8. Express Borda-Carnot equation and mention its usefulness.

9. Who is called the father of modern fluid mechanics and why?

10. Differentiate form drag and skin drag.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Calculate the capillary effect in millimeters a glass tube of 4 mm diameter, when immersed in (1) water and (2) mercury. The temperature of the liquid is 20° C and the values of the surface tension of water and mercury at 20° C in contact with air are 0.073575 and 0.51 N/m respectively. The angle of contact for water is zero that for mercury 130°. Take specific weight of water as 9790 N/m³. (4)

(ii) List the various devices used to measure fluid pressure and explain any two of the manometer with neat sketch. (9)

Or

(b) (i) Define weight density, specific gravity, specific volume and kinematic viscosity of a fluid with units. (8)

(ii) Distinguish Newtonian and non-Newtonian fluid. (5)

12. (a) Derive 3D continuity equation in differential form. (13)

Or

(b) Derive the Bernoulli's equation from Euler's Equation. (13)

13. (a) (i) The efficiency of a fan depends on the density ρ dynamic viscosity μ angular velocity ω, diameter D, discharge Q. Express efficiency in terms of dimensionless parameters using Rayleigh's Method. (8)

(ii) Define similitude and mention the three types of similarity with definition. (5)

Or

(b) Using Buckingham $\prod$-theorem, show that velocity of fluid through a circular orifice is given by $V = \sqrt{2gH}\ \phi\left(\frac{D}{H}, \frac{\mu}{\rho VH}\right)$. (13)

14. (a) (i) An oil of sp. gr. 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litres/s. Find the head lost due to friction for a 500 m length of pipe. Find the power required to maintain this flow. (10)

(ii) What are the major and minor losses in pipe flow? (3)

Or

(b) A pipe 5 cm diameter is 5m long and carries a discharge of 0.005 m^3/s. Find the loss of head due to friction.

Now, the central 2m length of the pipe is next replaced by a pipe 7.5 cm diameter; the changes of section being sudden. Take f = 0.01 for the pipe of both diameters and contraction loss coefficient = 0.5. Determine the total loss of head.

15. (a) For the velocity profile for laminar boundary layer

$$\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^2.$$

Determine the boundary layer thickness, shear stress, drag force and co-efficient of drag in terms of Reynold number. (13)

Or

(b) For air flow over a flat plate, velocity (U) and boundary layer thickness (δ) can he expressed respectively, as

$$\frac{U}{U_\infty} = \frac{3y}{2\delta} - \frac{1}{2}\left(\frac{y}{\delta}\right)^3 \text{ and } \delta = \frac{4.64x}{\sqrt{\mathrm{Re}_x}}$$

If the free stream velocity is 2 m/s. and air has kinematic viscosity of $1.5 \times 10^{-5}\ m^2/s$ and density of 1.23 kg/m³, Determine the wall shear stress at $x = 1$ m.

PART C — (1 × 15 = 15 marks)

16. (a) (i) Water is flowing through a pipe having diameter 300mm and 200mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.5 N/cm² and the pressure at the upper end is 9.81 N/cm². Determine the difference in datum head if the rate of flow through the pipe is 40 L/s. (7)

(ii) A piping system consists of three pipes arranged in series.

Pipe	Length	Diameter
AB	2000 m	40 cm
BC	1500 m	30 cm
CD	1000 m	20 cm

Transform the system to (1) an equivalent length of 30 cm diameter and (2) an equivalent diameter for the pipe 4500 m long. (8)

Or