This question paper contains 4 printed pages.

Your Roll No. .....

8454 **A**

B.Tech. (M)/II

PAPER EME–203—FLUID MECHANICS

Time : 3 *Hours* *Maximum Marks* : 70

(Write your Roll No. on the top immediately on receipt of this question paper.)

Answer any ***five*** *questions.*

All *questions carry equal marks.*

Assume suitable values of missing data, if any.

1. (a) Name and explain different model laws. Briefly explain geometric, kinematic and dynamic similarities. 7

   (b) Prove that for a steady laminar flow between two fixed parallel plates the velocity distribution is parabolic and that the average velocity is two-third of maximum velocity. 7

2. (a) The thrust 'T' of a propeller depends upon its diameter 'D', fluid density 'ρ', dynamic viscosity 'μ', revolutions per unit time 'N' and the velocity 'V'. By means of dimensional analysis show that the appropriate non-dimensional parameters are

$$T = \rho D^2 . V^2 \, f\left\{\frac{\mu}{VD\rho}, \frac{DN}{V}\right\}$$ 7

(b) Explain the procedure of measuring viscosity with the help of rotating cylinder viscometer. 7

3. (a) Show that, the condition of maximum transmission of power through a pipe line, is given by $h_f = \frac{H}{3}$, where h_f = head loss due to friction and H = total head available. 8

(b) Define and explain the following stagnation quantities :

(i) Stagnation temperature

(ii) Stagnation pressure

(iii) Stagnation enthalpy 6

4. (a) Define and distinguish between the following set of fluid properties :

(i) Surface tension and capillarity

(ii) Compressibility and bulk modulus of elasticity

(iii) Specific weight and specific gravity

(iv) Newtonian and non-Newtonian fluids 8

(b) A rectangular plate 0.6 m wide and 1.2 m deep is submerged in an oil bath of specific gravity 0.85. The maximum and minimum depths of the plate are 1.6 m and 0.75 m from the free surface. Calculate the hydrostatic force on one face of the plate, and the depth of centre of pressure. 6

5. (a) A solid metallic piece having relative density of 7.2 floats above the surface of mercury (relative density = 13.6) contained in a tank. What fraction of the volume of metallic piece lies above mercury surface ? 6

(b) Differentiate between Lagrangian and Eulerian view points of description of fluid flow. 4

(c) Derive the equation of stream lines. 4

6. (a) Which of the following velocity fields pertain to the motion of steady, two dimensional flow of an incompressible fluid ?

(i) $u = 2x^2 - 2x^2y$, $V = x^2 - 4y^2 + xy$

(ii) $\bar{u} = Ae^x\hat{i} - Ae^x y\hat{j}$ where A is a numerical constant. 6

(b) Determine whether the velocity field $\bar{u} = 3t\hat{i} + xz\hat{j} + ty^2\hat{k}$ is incompressible, irrotational or both or neither. 8

7. (a) Explain the following terms :

(i) Velocity potential function

(ii) Stream function

(iii) Circulation 6

(b) Explain a uniform flow parallel to y-axis and obtain the expressions for stream and velocity potential functions. Draw the pattern of streamlines and potential lines. 8

8. (a) Define and explain Bernoulli's theorem. Specify the assumptions for the validity of Bernoulli's equation. 6

(b) A pipe line carrying oil of specific gravity 0.87 changes in diameter from 200 mm at a position A to 500 mm at position B which is 4m at a higher level. If the pressures at A and B are 1 bar and 0.6 bar respectively and the discharge is 0.2 m^3/s, determine the loss of head and direction of flow. 8