

Total No. of Questions : 8]

PE4347

SEAT No. :

[Total No. of Pages : 3

[6582]-121

S.E. (Automobile & Mechanical Engineering)

FLUID MECHANICS

(2019 Pattern) (Semester - IV) (202049)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Figures to the right indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Assume suitable data, if necessary.

Q1) a) A fluid flow field is given by  $V = x^2yi + y^2zj - (2xyz + yz^2)k$ . Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2, 1, 3). [9]

b) Derive the equation of continuity. Obtain an expression continuity equation for a three dimensional flow. [8]

OR

Q2) a) The stream function for a two-dimensional flow is given by  $\Psi = 2xy$ , Calculate the velocity at the point (2, 3). Find the velocity potential function  $\phi$ . [9]

b) Explain the terms : [8]

- i) Path line
- ii) Streak line
- iii) Stream line
- iv) Stream tube

Q3) a) A pitot-tube is inserted in a pipe of 300 mm diameter. The static pressure in pipe is 100 mm of Mercury (Vacuum). The stagnation pressure at the center of pipe recorded by the pitot tube is 0.981 N/cm<sup>2</sup>. Calculate the rate of flow of water through pipe, if the mean velocity of flow is 0.85 times the center velocity. Take  $C_v = 0.98$ . [9]

b) Derive an expression to find theoretical discharge for venturimeter from Bernoulli's theorem. [9]

OR

P.T.O.

**Q4) a)** Two horizontal fixed parallel plates are 20 mm apart. Liquid of specific gravity 0.66 flows between the plates. Velocity at 5 mm from lower plate is 1.2 m/s. Estimate: [9]

i) Mean Velocity &

ii) Viscosity of liquid by assuming laminar flow and head loss of 1.6 m per meter length.

b) Prove that the maximum velocity in circular pipe for viscous flow is equal to two times the average velocity of the flow. [9]

**Q5) a)** Derive Darcy-Weisbach equation to find head loss due to friction. [8]

b) A Pipe of diameter 300 mm and length 3500 m is used for the transmission of power by water. The total head at the inlet of the pipe is 500 m. Find the maximum power available at the outlet of the pipe, if the value of  $f = 0.006$ . [9]

OR

**Q6) a)** Find the displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by,

$\frac{u}{U} + \frac{y}{\delta}$  Where,  $u$  is the velocity at a distance  $y$  from the plate and  $u = U$ , at  $y = \delta$ , where  $\delta$  is boundary layer thickness. [8]

b) A kite of area  $0.25 \text{ m}^2$  and  $1.2 \text{ N}$  weight is flying in wind of velocity  $20 \text{ km/hr}$ . When the string is inclined at angle of  $15^\circ$  to the vertical the tension in the string was found to be  $3 \text{ N}$ . Evaluate the coefficient of lift and drag. Take density of air  $= 1.15 \text{ kg/m}^3$  [9]

**Q7) a)** The frictional torque  $T$  of a disc of diameter  $D$  rotating at a speed  $N$  in a fluid of viscosity  $\mu$  and density  $\rho$  in a turbulent flow is given by  $T = D^5 N^2 \rho \Phi [\mu/(D^2 N \rho)]$  prove this by the method of dimensions. [9]

b) Explain the following non-dimensional numbers: [9]

i) Reynold's number

ii) Froude's number

iii) Mach's number

What are their significances for fluid flow problems?

OR

Q8) a) Water is flowing through a pipe of diameter 30 cm at a velocity of 4m/s. Find the velocity of oil flowing in another pipe of diameter 10 cm, if the condition of dynamic similarity is satisfied between the two pipes. The viscosity of water and oil is given as 0.01 poise and 0.25 poise. The sp.gr. of oil = 0.8. [9]

b) Prove that the scale ratio for discharge for a distorted model is given as

$$Q_p / Q_m = (L_r)_H \times (L_r)_V^{3/2} \quad [9]$$

Where

$Q_p$  = Discharge through Prototype

$Q_m$  = Discharge through model

$(L_r)_H$  = Horizontal scale ratio

$(L_r)_V$  = Vertical scale ratio

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