005 / PCC-CE305 - Fluid Mechanics-I

P. Pages : 2

Time : Three Hours

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2188

GUG/S/25/13713

Max. Marks : 80

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Notes : 1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and Chemical equation should be given wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Find out the minimum size of glass tube that can be used to measure water level if the capillary rise in the tube is to be restricted to 2mm. Consider surface tension of water in contact with air as 0.073575 N/m. **8**

b) Explain Rheological diagram in detail. **8**

OR

2. a) What do you mean by dimensionless numbers? Derive the expression the for **8**
i) Reynold's Number ii) Mach number

b) State and explain Buckingham π theorem. **8**

3. a) Define and explain the following term **8**
i) Piezometer ii) U-tube manometer

b) A rectangular plane surface 2m wide and 3m deep lies in water in a such a way that its plane makes an angle of 30° with the free surface of water. Determine the total pressure and position of centre of pressure when the upper edge is 1.5m below the free water surface. **8**

OR

4. a) Derive the expression for Metacentric height for the floating body. **8**

b) A solid cylinder of diameter 4.0m has a height of 3.0m. Find the metacentric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder = 0.6. **8**

5. a) Show that the equipotential lines are orthogonal to the stream lines at all points of intersection. **8**

b) The velocity components in a two-dimensional flow field for an imcompressible fluid are as follows: **8**

$$u = \frac{y^3}{3} + 2x - x^2y \text{ and}$$

$$v = xy^2 - 2y - \frac{x^3}{3}$$

Obtain an expression for the stream function ψ .

OR

6. a) A horizontal venturi meter with inlet and throat diameter 30cm and 15cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20cm of mercury. Determine the rate of flow. Take Cd = 0.98. **8**

b) Find the discharge over a triangular notch of angle 60º when the head over the V notch is 0.3m. Assume Cd=0.6. **8**

7. a) Explain Reynold's Experiment. **8**

b) Calculate: **8**
   i) The pressure gradient along flow,
   ii) The average velocity and
   iii) The discharge for an oil of viscosity $0.02 \, \text{Ns} / \text{m}^2$ flowing between two stationary parallel plates 1m wide maintained 10mm apart. The velocity midway between the plates is 2 m/s.

OR

8. a) Explain Hydro-dynamically smooth & rough boundaries. **8**

b) Explain in detail boundary layer separation and its control. **8**

9. a) Derive expression for Dupit's equation. **8**

b) The difference in water surface level in two tanks which are connected by three pipes in series of length 300m, 170m and 210m and of diameters 300mm, 200mm and 400mm respectively is 12m. Determine the rate of flow of water if co-efficient of friction are 0.005, 0.0052 and 0.0048 respectively, consider: **8**
   i) Minor losses also
   ii) Neglecting Miner losses

OR

10. a) Explain in detail Prandtl's mixing length theory. **8**

b) Derive Dancy's Weisbach equation for head loss in pipe due to friction. **8**

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