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Paper Code : CE(ES)401 Introduction to Fluid Mechanics

UPID : 004443

Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.

Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following :

[1 x 10 = 10]

- (i) To measure very low pressure, we use _____.
- (ii) The type of flow in which the velocity at any given time changes with respect to space is known as _____.
- (iii) Pitot tube is used to measure _____.
- (iv) Reynold's no is the ratio of inertia of a flowing fluid to the _____ force of the liquid.
- (v) The loss of energy due to sudden enlargement _____
(where V_1 and V_2 are the velocities before and after enlargement).
- (vi) The frictional resistance of fluids in the motion is proportional to the square of the velocity in an turbulent flow.
(true/false)
- (vii) If the specific speed of a turbine more than 300, the type of turbine is _____.
- (viii) Write down one example of ideal plastic fluid.
- (ix) In case of triangle plane surface of height (h) and base width (b), its moment of inertia about base (I_O) _____.
- (x) The product of the slope of the equipotential line and stream line at the point of intersection is equal to _____.
- (xi) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm^2 (gauge) and with mean velocity of 2.0 m/sec. The kinetic head equal to _____.
- (xii) In 1 in 40 model of a spillway, the velocity is 2m/sec. Find the corresponding velocity in prototype.

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. Prove the Dupit's equation. [5]
3. An inward flow reaction turbine has external and internal diameters as 1 m and 0.5 m respectively. The velocity of flow through the runner is constant and is equal to 1.5 m/sec. Determine : discharge through the runner, width of the turbine at outline if the width of the turbine at inlet = 200 mm. [5]
4. Define surface tension. The pressure outside the droplet of water diameter 0.04 mm is 10.32 N/cm^2 (atmospheric pressure). Calculate the pressure within the droplet if surface tension is given as 0.0725 N/m of water. [5]
5. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size $0.8 \text{ m} \times 0.8 \text{ m}$ and an inclined plane with angle of inclination 30° as shown in Fig. 1.4. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm. [5]

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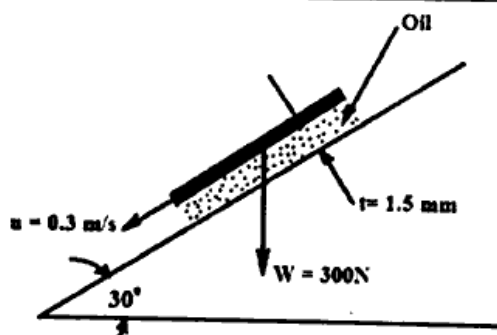


Fig.1.4

6. A rectangular sluice gate is situated on the vertical wall of lock. The vertical side of the sluice is (d) meters in length and depth of centroid of area (P) meter below the water surface. Prove the depth of pressure is equal to $h^* = p + D^2/12p$ [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. (a) What do you mean by dimensional homogeneity? [3]
 (b) Water is flowing through a pipe of diameter 30 cm at a velocity of 4m/sec. Find the velocity of oil flowing in another pipe of diameter 10cm, 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 [7]
- (c) In the model test of a spillway the discharge and velocity of flow over the model were 2m³/sec. and 1.5m/sec respectively. Calculate the velocity and discharge over the prototype which is 36 times the model size. [5]
8. (a) Write a short note about Prandtl mixing length theory for turbulent shear stress. [6]
 (b) A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100mm and length 10m. Calculate the difference of pressure at the two ends of the pipe, if 100kg of the oil is collected in a tank in 30 seconds. [9]
9. A pipe of diameter 20cm and length 2000m connects two reservoirs, having difference of water levels as 20m. Determine the discharge through the pipe. If an additional pipe of diameter 20cm and length 1200m is attached to the last 1200m length of the existing pipe, find the increase in discharge. Take $f=0.015$ and neglect all minor losses. <https://www.makaut.com> [15]
10. (a) Discuss following parts of the Pelton wheel: **Nozzle and flow regulating arrangement** [3]
 (b) Discuss following parts of the Pelton wheel: **Runner and buckets** [3]
 (c) Discuss following parts of the Pelton wheel: **casing** [3]
 (d) Discuss following parts of the Pelton wheel: **Breaking jet, jet ratio** [6]
11. A cubical tank has sides of 1.5 m. It contains water for the lower 0.6 m depth. The upper remaining part is filled with oil of specific gravity 0.9. Calculate for one vertical side of the tank: [15]
 (a) total pressure, and
 (b) position of centre of pressure.

*** END OF PAPER ***