Seat No. | | | | | | |

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मजल - 013

Fluid Mechanics - I
(1100)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory & Solve **any two** but out of a, b & c at one place only.
5. Figures to right indicate full marks.
6. Use of Non-programmable calculator is allowed.
7. Assume suitable data if necessary.

UNIT - I

1. a) A circular disc of diameter "d" is slowly rotated in a liquid of large viscosity "μ" at a small distance "h" from a fixed surface. Derive an expression for torque "T" necessary to maintain an angular velocity of "ω" in the form.

$$T = \frac{\pi \mu \omega d^4}{32h}.$$ **10**

b) A square plate of diagonal 1.5m is immersed in water with it's diagonal vertical and upper corner 0.5m below the free surface of water. Find the hydrostatic force on the plate and the depth of centre of pressure from free surface of water. **10**

c) A right solid one floats in water with its apex down wards and base horizontal. It has diameter "d" and height "h". If the specific gravity of the cone is "s". Show that for stable equilibrium.

$$h^2 < \frac{1}{4} \frac{d^2 S^{1/3}}{\left(1 - S^{1/3}\right)}$$ **10**

UNIT - II

2. a) A pipe line is 15 cm in diameter and is at an elevation of 100.00m at section A. At section B, it is an elevation of 107.00 m and has a diameter of 30 cm. When a discharge of 50 L/S of water is passed through this pipe, the pressure at section A is observed to be 30 KPa. The energy loss in the pipe is 2 m. Calculate the pressure at B when the flow is (i) From A to B (ii) From B to A. **10**

b) The inlet and throat diameters of a vertically mounted venturimeter are 30 cm and 10 cm respectively the throat section is below the inlet section at a distance of 10 cm. The specific gravity of the liquid is 900 kg/m^2. The intensity of pressure at inlet is 140 kPa and the throat pressure is 80 kPa. Calculate the flow rate in l.p.s. Assume that 2% of the differential head is lost between inlet and throat & coeff of discharge 0.97. **10**

c) i) Describe the use and limitation of the flow net. **6**

ii) Name the different forces present in a fluid flow for the Euler's equation of motion. Which forces are taken into consideration **4**

UNIT - II

3. a) The pressure drop 'Δp' in a pipeline of diameter "D" and length "L" depends upon density 'ρ' and viscosity 'μ' of flowing fluids, mean velocity "v" and average height of roughness projection "k" . Obtain an expression for "Δp".

$$h_f = \frac{\Delta p}{r} = \frac{f \cdot L\ V^2}{D \cdot 2g}$$

where, $h_f \rightarrow$ loss of head due to friction = $\frac{\Delta p}{r}$

$r \rightarrow$ is the sp. wt. of fluid.

$f \rightarrow$ frictional resistance coeff. **10**

b) Oil is pumped in a 200 mm diameter, 1 km long pipeline at the rate of 5300 N/min. The pipe line is laid at an upgrade of 1:100. The specific weight of oil is 8833 N/m^3 and its viscosity is 20 stokes. Find the power required to pump the oil. **10**

c) A model of a water meter is tested in pipe of 10 mm diameter. The discharge was found to be 50 lit/sec, when the pressure difference was 0.1 N/mm^2. What will be the discharge in a pipe 500 nm diameter, if the dynamic similarity is maintained ? What will be the pressure drop ? **10**

UNIT - IV

4. a) Derive an expression for coefficient of discharge for an external cylindrical mouthpiece. **10**

b) A Vessel has two identical orifices A and B with identical values of Cv provided in one of its virtual sides at depth H_a and H_b, below the liquid surface in the tank respectively show that the point of intersection of the two jets is H_b below orifice A and H_a below orifice B. Further find the distance of the point of intersection from the plane of the orifices. **10**

c) A 10 cm high, sharp crested, rectangular weir span the full width of a 0.80 m rectangular channel and is installed at the end of channel. What maximum discharge can be passed in this channel, if the side walls are 0.75 m high and the minimum specified free board is 15 cm. **10**

UNIT - V

5. a) Derive Chezy's formula for uniform flow in an open channel ? How chezy's constant and Manning's constant are related ? **10**

b) What size of a circular drainage pipe is needed to carry 1.10 m^3/s of discharge, when flowing half full ? The pipe is laid at a slope of 0.0004 and the Manning's n for the pipe can be taken as 0.018. **10**

c) Define critical depth, specific energy, uniform flow, Non-uniform flow. A rectangular channel 3.5 m wide is laid on a slope of 0.005. Calculate the normal depth of flow for a discharge of 5.0 m^3/s in this channel. The Manning's coeff n = 0.02. **10**

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