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320312 (20)

BE (3rd Semester)

Examination, April - May, 2021

Branch : Civil

FLUID MECHANICS - I

Time Allowed : Three Hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Attempt any three parts of each question. Part (a)

is compulsory. Wherever necessary make

suitable assumptions/data and mention it clearly.

Q. 1. (a) Differentiate between Newtonian and Non-

Newtonian fluid.

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(b) A vertical shutter revolving about a horizontal axis sustains a pressure of 4 m of water on one side. At what depth should the axis be placed in order that the pressure on the portions of the shutter above and below the axis may be equal. 7

(c) A pipe containing water at 172 kN/m² pressure is connected by a differential gage to another pipe 1.5 m lower than the first pipe and containing water at high pressure. If the difference in heights of the two mercury columns of the gage is equal to 75 mm. What is the pressure in the lower pipe ? Specific gravity of mercury is 13.6. 7

(3)

(d) What is meant by stability of a floating body? Explain the stability of floating body with reference to its metacentric height, give neat sketches. 7

Q. 2. (a) Define and distinguish between stream line, path line and streak line. 2

(b) The velocity vector in an incompressible flow is given by : 7

$$V = (6xt + yz^2) i + (3t + xy^2) j + (xy - 2xyz - 6tz) k$$

(i) Verify whether the continuity equation is satisfied.

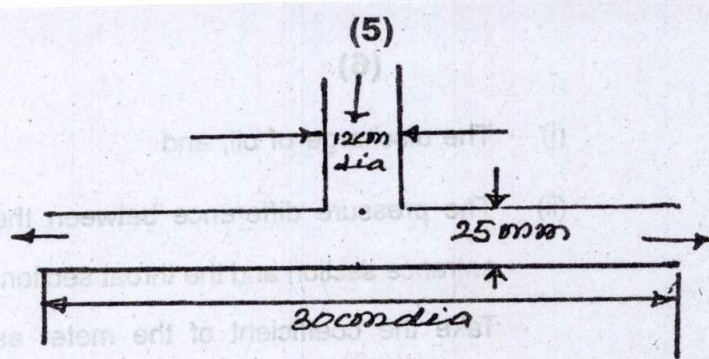
(ii) Determine the acceleration vector at point A(1, 1, 1) at t = 1.0.

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(c) Show that stream lines and equipotential lines intersect each other orthogonally at all points of intersection. 7

(d) A centrifugal pump has an axial inlet of 12 cm diameter and an impeller of 30 cm diameter. The width of the impeller at the outlet is 25 mm (Fig.1). For a flow of 80 litre/sec estimate the radial component of velocity at the outlet of the impeller. What is the axial velocity in the inlet pipe. Find also the radial velocity at a section 5 cm from centre of impeller. 7

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Q. 3. (a) What are the different energies of a fluid ?

Explain them briefly.

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(b) A 300 mm × 150 mm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards.

The difference in elevation of the throat section and the entrance section of the venturimeter is 300 mm. The differential

U-tube mercury manometer shows a gauge deflection of 250 mm. Calculate :

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- (i) The discharge of oil, and
- (ii) The pressure difference between the entrance section and the throat section.

Take the coefficient of the meter as 0.98 and the specific gravity of mercury as 13.6.

- (c) 250 litres per second of water is flowing in a pipe having a diameter of 300 mm. If the pipe is bent by 135° , find the magnitude and direction of the resultant force on the bend. The pressure of water flowing in the pipe is 390 kPa. 7

- (d) Derive the expression for force exerted by jet striking an unsymmetrical curved vane tangentially at one of the tips. 7

Q. 4. (a) Compare open channel and pipe flow. 2

- (b) A trapezoidal channel has to convey a discharge of 15 cumecs of water at a velocity of 1.20 m/s. The side slopes of the

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channel are 1 horizontal to 1 vertical. Find the sectional dimensions for the most efficient conditions. Find also the necessary bed slope of the channel if the value of Chezy's constant is 60. 7

(c) Find the width and depth of a rectangular channel to convey a discharge of $1.45 \text{ m}^3/\text{s}$ at a velocity of 0.50 m/s . The bed of the channel has a slope of 0.0001 . Take Manning's coefficient $n = 0.014$. 7

(d) Derive an expression for mean velocity for laminar flow between parallel plates. 7

Q. 5. (a) What is submerged weir? Draw the definition sketch also. 2

(b) A discharge of 100 litre/s is to be measured by a triangular notch of vertex angle 60° , what would be the head over the vertex of

(8)

the notch? If the accuracy of reading the head is 1 mm, what error in discharge can be expected at this level. Assume $C_d = 0.58$. 7

(c) The head lost in flow through a 50 mm diameter orifice under a certain head is 160 mm of water and the velocity of water in the jet is 7.0 m/s. If the coefficient of discharge be 0.61, determine : 7

- (i) Head on the orifice causing flow;
- (ii) The co-efficient of velocity;
- (iii) The diameter of the jet.

(d) Write short notes on different type of weirs and mouthpieces. 7