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320352(20)

B. E. (Third Semester) Examination, April-May 2020

(New Scheme)

(Civil, Agricultural Engg. Branch)

FLUID MECHANICS-I

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

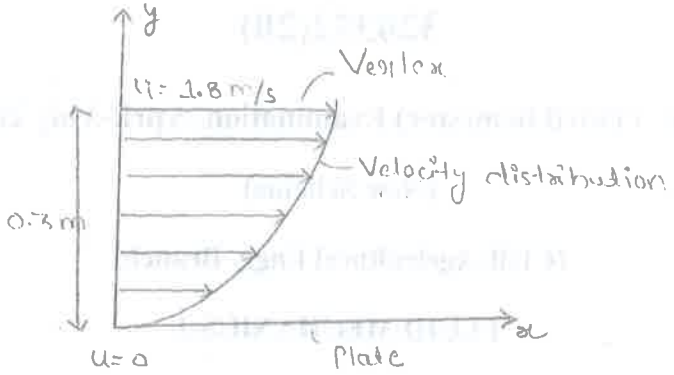
Note : *Part (a) is compulsory from each unit. Attempt any* ***two*** *parts from remaining (b), (c) and (d).*

Unit-I

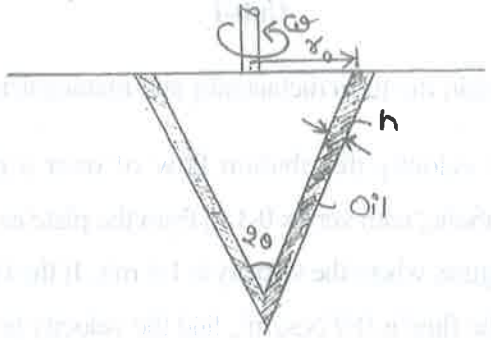
1. (a) Explain the term metacenter and metacentric height. 2

(b) The velocity distribution flow of over a plate is parabolic, with vertex 0·3 m from the plate as shown in figure, where the velocity is 1·8 m/s. If the viscosity of the fluid is 0·9 N.s./m^2, find the velocity gradients

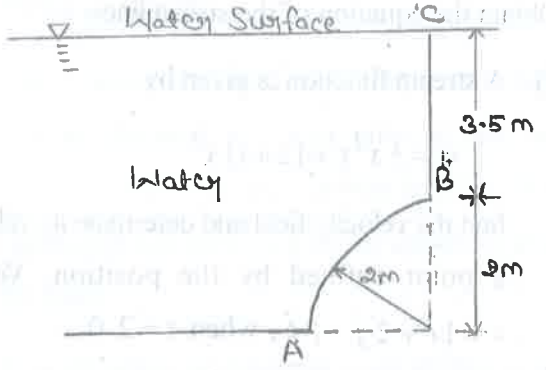
and shear stresses at distances 0 m, 0·15 m and 0·3 m from the plate. 7



(c) A solid cone of radius 'r_0' and vertex angle '2 θ' is to rotate at an angular velocity 'w'. An oil of viscosity 'μ' and thickness 'h' fills the gap between the cone and the housing. Determine the torque 'T' to rotate the cone.



(d) A door in a tank is in the form of a quadrant of a cylinder of 2 m radius and 3 m width, as shown in figure. Calculate the resultant force on the door and it's location on the gate. 7



Unit-II

2. (a) Differentiate between the Eulerian and Lagrangian method of representing fluid motion. 2

(b) Show that : 4

$$u = \frac{-2xyz}{\left(x^2+y^2\right)^2}$$

$$v = \frac{\left(x^2-y^2\right)z}{\left(x^2+y^2\right)^2} \text{ and}$$

$$w = \frac{y}{\left(x^2+y^2\right)}$$

are the velocity components of a possible liquid motion. In this motion irrotational.

(b) Given the velocity field, $V = 2x^3\,\hat{i} - 6x^2y\,\hat{j}$. Obtain the equation of the streamlines. 3

(c) (i) A stream function is given by

$$\psi = 3x^2y + (2+t)\,y^2$$

find the velocity field and determine its value at a point defined by the position. Vector $r = 1\,\hat{i} + 2\,\hat{j} - 3\,\hat{k}$, when $t = 2{\cdot}0$. 4

(ii) Explain the use and limitation of flow net. 3

(d) Check whether the flow defined by the stream function, $\psi = 2xy$ is irrotational? If so, determine the corresponding velocity potential. 7

Unit-III

3. (a) Sketch a pitot tube and explain how it is used to measure the velocity of a flowing liquid. 2

(b) A venturimeter is installed in a horizontal pipe line of 0·3 m diameter. The difference of pressure at

entrance and throat read by a mercury manometer is 5 cm. When the water is flowing at the rate of 50 litres per second. Find the diameter of the venturimeter at the throat, if the coefficient of discharge is 0·96. 7

(c) Water under pressure of $3{\cdot}924 \times 10^{-3}$ N/m^2 is flowing through a 0·3 m pipe at the rate of 0·25 cumecs. If the pipe is bent by 135°, find the magnitude and direction of the resultant force on the bend. 7

(d) A jet of water of diameter 6 cm strikes a curved plate at its center with a velocity of 25 m/s. The curved plate is moving with a velocity of 10 m/s in the direction of the jet. The jet is deflected through an angle of 160°. Assuming the plate as smooth find :

(i) Force exerted on the plate in the direction of jet

(ii) Efficiency of the jet 7

Unit-IV

4. (a) Define Froude's Number and derive expression for it. 2

(b) A town with a population of 1,50,000 persons is supplied with water through a pipeline from a reservoir 100 km away. Water is consumed by the population at the rate of 130 *l*/head/day. The supply is continuous. Considering only the friction loss, find the suitable size of the pipeline. The difference of levels betwen the reservoir water surface and centerline of the pipeline at the town end is 45 m. Take $f = 0{\cdot}01$. 7

(c) (i) A compound pipeline 1500 m long is made up of pipes 40 cm diameter for 700 m, 30 cm diameter for 500 m and 25 cm for 300 m and is required to be replaced by a pipe of uniform diameter. Find the diameter of the new pipe, assuming the length to remain the same. 4

(ii) Find the slope of the bed of a rectangular channel of width 8·5 m when depth of water is 3·5 m and rate of flow is given as 30 cumecs. Assume Chezy's constant $C = 55$. 3

(d) A trapezoidal channel has a side slope of 1 H to 2 V and the slope of the bed is 1 in 2000. The area of section is 30 m^2. Find the dimensions of the sections, if it is most economical. Determine the discharge of the most economical section if $C = 60$. 7

Unit-V

5. (a) Explain the term Vena-contracta. 2

(b) A 40 mm diameter orifice is provided in a tank containing water to a height of 1·2 m above the centre of the orifice. The values of C_v and C_c are 0·98 and 0·62, respectively.

Find :

(i) Coefficient of discharge (C_d)

(ii) theoretical discharge

(iii) actual discharge 7

(c) A rectangular notch has a discharge of 0·4 cumecs when the head is halt the breadth of the notch. Find the breadth of the notch. Take $C_d = 0{\cdot}6$. 7

(d) A weir 10 m long is to be built across a rectangular

channel to discharge a flow of 10·5 cumecs. If the maximum depth of water on the upstream side of the weir is to be 2·25 m, what should be the height of the weir? Neglect end contraction. Assume $C_d = 0 \cdot 62$. 7