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53 [CE 303) FLMC

2019

FLUID MECHANICS

Paper : CE 303

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Derive Bernoulli's equation for flow and state all the assumptions. 7

   (b) A pitot-static tube is placed in an air flow $\left(\rho = 1{\cdot}3\ kg/m^3\right)$. A connected manometer shows pressure difference 20 *mm* of water. Determine the velocity of flow. 5

   (c) Find the discharge of water flowing over a rectangular notch of 2 *m* length when the constant head over the notch is 300 *mm*. Take $C_d = 0{\cdot}60$. 3

Contd.

(d) What are the major and minor losses in a pipeline ? 5

2. (a) Define the following coefficient : 6

(i) Coefficient of velocity

(ii) Coefficient of discharge

(iii) Coefficient of contraction.

(b) Find the actual discharge and actual velocity of the set at Vena contracta, if the head of water over an orifice of diameter is 10 *m*. Take $C_d = 0{\cdot}6$ and $C_V = 0{\cdot}98$. 4

(c) Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional flow. 6

(d) Differentiate between : 4

(i) Laminar flow and Turbulent flow

(ii) Steady flow and Unsteady flow.

3. (a) How are the weirs and notches classified ? 5

(b) Prove that the discharge through a rectangular notch or weir is given by $\theta = \frac{2}{3} C_d * L * \sqrt{2g}\, H^{3/2}$. 5

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(c) At a sudden enlargement of a water main from 240 *mm* to 480 *mm* diameter the hydraulic gradient rises by 10 *mm*. Estimate the rate of flow. 5

(d) State Buckingham's π theorem. How are the repeating variables selected in dimensional analysis ? 5

4. (a) Define and explain the terms 6

(i) Total energy line

(ii) Hydraulic gradient line.

(b) Three pipes of the same length L, diameter D and friction factor f are connected in parallel. Determine the diameter of the pipe length L and frictional factor f which will carry the same discharge for the same head loss. Use the formula $h_f = f * L * V^2/2gD$. 5

(c) Obtain an expression for equivalent pipe. 5

(d) The diameter of a pipe at the section 1 and 2 are 10 *cm* and 15 *cm* respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5 *m/sec*. Determine also the velocity at section 2. 4

5. *(a)* The velocity vector in a fluid flow is given by $V = 2x^3 i - 5x^2 yj + 4tk$. Find the velocity and acceleration of a fluid particle at (1, 2, 3) at $t = 1$. 8

(b) Derive expression for stream and velocity potential functions. 6

(c) Define orifice and mouthpiece. Prove that the expression for discharge through an external mouthpiece is given by $Q = 0{\cdot}855 * a * v$, where a = area of mouthpiece at outlet, v = velocity of jet of water at outlet. 6

6. *(a)* What is Euler's equation of Motion? How will you obtain Bernoulli's equation from it? 6

(b) What are the methods of dimensional analysis? Explain the Rayleigh's method for dimensional analysis. 6

(c) Define and explain : 6

(i) Froude number

(ii) Reynolds number

(iii) Mach number.

(d) A pitot-static tube is used to measure the velocity of water in a pipe. The stagnation pressure head is 6 m and static pressure head is 5 m. Calculate the velocity of flow assuming the coefficient of tube equal to 0·98. 2

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