Total number of printed pages = 4

2022

FLUID MECHANICS

Full Marks –100

Time – Three hours

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

Answer any *five* questions.

1. (a) Explain the various types of fluid flow. 8

   (b) Define continuity equation. Obtain an expression for continuity equation for a three dimensional flow. 12

2. (a) The velocity vector in a fluid flow is given = $2x^3i - 5x^2yj + 4tk$, find the velocity and acceleration of a fluid at (1,2,3) at t = 1. 10

   (b) The diameter of a pipe at the sections 1 and 2 are 15 cm and 20 cm respectively. Find the discharge through the pipe if the velocity of water at section 1 is 4 m/sec, Determine also the velocity at section 2. 5

   (c) What are the different types of forces present in a fluid flow ? 5

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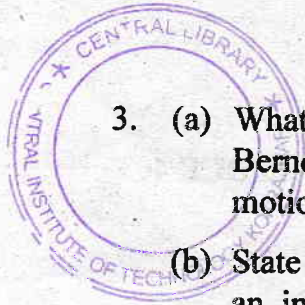
3. (a) What is Euler's equation of motion ? Derive Bernoulli's equation from Euler's equation of motion. 10

(b) State Bernoulli's theorem for steady flow of an incompressible fluid. 4

(b) A horizontal venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to inlet and throat is 10 cm of mercury. Determine the rate of flow. Take $Cd = 0.98$. 6

4. (a) The water is flowing through a pipe having diameters 20 cm and 10 cm at section 1 and 2 respectively. The rate of flow through pipe is 35 litres/sec. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is $39.24 N/cm^2$, find the intensity of pressure at section 2. 6
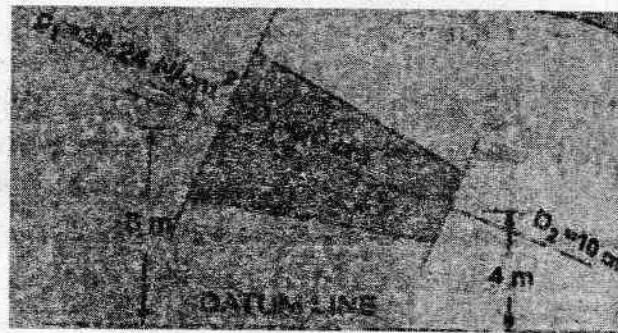
(b) What is Venturimeter ? Derive an expression for the discharge through a venturimeter.

6

(c) Define the term 'major energy loss' and 'minor energy loss'. Explain the various types of energy losses through pipe. 8

5. (a) Classify mouthpiece. An internal mouthpiece of 100 mm diameter is discharging water under a constant head of 5m, find the discharge through a mouthpiece, when (i) the mouthpiece is running free (ii) the mouthpiece is running full. 7

(b) Define the following coefficient : 2×3=6
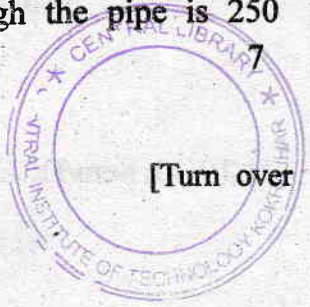
(i) Coefficient of velocity

(ii) Coefficient of discharge

iii) Coefficient of contraction.

(c) What is a pitot-tube ? Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm, the rate of flow of water through the pipe is 250 litres/sec. 7

6. (a) The head of water over an orifice of diameter 50 mm is 12m, find the actual discharge and actual velocity of jet at venacontracta. Take Cd = 0.6 and Cv = 0.98.   5

(b) Define and explain the terms 'hydraulic gradient line' and 'total energy line'.   5

(c) Define the terms 'dimensional analysis'. Define and explain Reynold's number, Froude's number and Mach's number.   10