REVISION 2021

(3051)

FUNDAMENTALS OF FLUID MECHANICS

CO 02

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COURSE OUTCOMES - 2 :

Choose the principle of fluid flow, its applications and various losses.

QUESTION PAPER PATTERN

Total Marks: 75 **Time: 3 Hrs**

Part A (9 Marks)

- 1 mark x 9 Questions

Part B (24 Marks)

- 3 marks x 8 Questions

Part C (42 Marks)

- 7 marks x 6 Questions

A3. When the Reynolds number is less than 2000 the fluid flow is generally.....

- If the value of Re is lies between **0 to 2000**, the flow of the liquid is streamlined or laminar.
- If the value of Re is above 4000, the flow is turbulent,
- Flows with Reynolds numbers between 2000 and 3500 are called transitional flows

A4. Venturi metre is used for.....

- Discharge measurement

A5. The ratio of actual discharge to theoretical discharge is called .....

Coefficient Of discharge (Cd)

Coefficient of discharge = $\frac{Actual\ discharge}{Theoretical\ discharge}$

B3. State bernoulli's theorem and write the equation

- This theorem is a form of the well known principle of conservation of energy.
- The theorem is stated as follows. "In a steady continuous flow of frictionless incompressible fluid, the sum of the potential energy head, pressure energy head and kinetic energy head is the same at all points".
- **$z + p/\rho g + v^2/2g = \text{constant}$**

B4. Differentiate between the steady flow and unsteady flow

Steady flow

- The type of flow in which the fluid characteristics like velocity, pressure, density, etc. at a point do not change with time is called steady flow.
- Mathematically this is translated to $\partial v / \partial t = 0$,
- Example- Liquid flow through a pipe

Unsteady flow

- It is that type of flow in which the velocity, pressure or density at a point change with respect to time.
- Example- decreasing water level of the reservoir

B5. A rectangular notch 1.8 m wide has a constant head of 4,6 m. Taking the coefficient of discharge as 0.62, calculate the discharge

Given datas,

Width , L=1.8m

Head , H= 4.6m

Coefficient of Discharge, Cd= 0.62

Discharge of Rectangular notch ,

Discharge , Q = 2/3.Cd.L.$\sqrt{2g}$ $[H]^{3/2}$

= 2/3 x 0.62x1.8.x4.43x 9.87

= 32.5 Cub.m/sec

C3. Explain the energy possessed by the flowing liquid

Hydraulic Energy (Energy Of Liquid In Motion)

- Hydraulic energy is the capacity of a liquid to do work. It exists in different interchangeable forms.
- In fluid mechanics we study the following three types of energies.
  1. Pressure energy or Flow energy
  2. Potential energy or Elevation energy or Static energy
  3. Kinetic energy or Velocity energy.

Sum of these three energies are called total energy.

1.Pressure energy

Pressure exerted by the liquid on the piston is P = ρ g h where h is the height of liquid column above the axis of the side tube.

We know that, Sp. weight, w = ρ g

ρ = Density

Pressure head, h = ��/�� in meters of liquid per kg.

Pressure head, **h =** ��/���� meter of fluid.

2. Potential Energy

It is the energy possessed by a fluid body by virtue of its position or location in space.

If a point 'A' in liquid is at a height of 'z' meters from a datum plane.

The potential energy per Newton of fluid = Z meter of fluid

- **3. Kinetic Energy or Velocity Energy**

Energy possessed by liquid in motion due to its velocity is called K.E.

Kinetic Energy,KE =1/2 mv^2

Kinetic head or Velocity head = $\frac{v^2}{2g}$ meter of fluid

TOTAL ENERGY

Total energy (E) of liquid in motion is the sum of Pressure energy, Potential energy and Kinetic energy.

Hence,

$$E = \frac{p}{\rho g} + \frac{v^2}{2g} + Z$$

Or we say that, the total head = $\frac{p}{\rho g} + \frac{v^2}{2g} + z$ meter of fluid.

C4.

1. A venturimeter with a 150 mm diameter at inlet and 100mm at throat is laid with its axis horizontal and is used for measuring the flow of oil of specific gravity 0.9. the mercury differential manometer shows a gauge difference of 200 mm. assume coefficient of meter as 0.98. calculate the discharge in litres per minute.

Solution. Given : $d_1 = 150$ mm $= 0{\cdot}15$ m; $d_2 = 100$ mm $= 0{\cdot}1$ m; Specific gravity of oil $= 0{\cdot}9$; $h = 200$ mm $= 0{\cdot}2$ m of mercury and $C = 0{\cdot}98$.

We know that the area at inlet,

$$a_1 = \frac{\pi}{4} \times (d_1)^2 = \frac{\pi}{4} \times (0{\cdot}15)^2 = 17{\cdot}67 \times 10^{-3} \text{ m}^2$$

ıd the area at throat,

$$a_2 = \frac{\pi}{4} \times (d_2)^2 = \frac{\pi}{4} \times (0{\cdot}1)^2 = 7{\cdot}854 \times 10^{-3} \text{ m}^2$$

We also know that the difference of pressure head,

$$h = 0{\cdot}2\left(\frac{13{\cdot}6 - 0{\cdot}9}{0{\cdot}9}\right) = 2{\cdot}82 \text{ m of oil}$$

and the discharge through the venturimeter,

$$Q = \frac{C \cdot a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \sqrt{2gh}$$

$$= \frac{0{\cdot}98 \times (17{\cdot}67 \times 10^{-3}) \times (7{\cdot}854 \times 10^{-3})}{\sqrt{(17{\cdot}67 \times 10^{-3})^2 - (7{\cdot}854 \times 10^{-3})^2}} \times \sqrt{2 \times 9{\cdot}81 \times 2{\cdot}82} \text{ m}^3/\text{s}$$

$$= \frac{136 \times 10^{-6}}{15{\cdot}83 \times 10^{-3}} \times 7{\cdot}44 = 63{\cdot}9 \times 10^{-3} \text{ m}^3/\text{s} = 63{\cdot}9 \text{ litres/s}$$

$$= 63{\cdot}9 \times 60 = 3834 \text{ litres/min}$$ **Ans.**

Study well