

Department of Chemical Engineering, IET Lucknow-226021

Class Test-I

Chemical Engineering Fluid Mechanics (ICH-302); Duration: 1 hr; Total Marks: 20; Date: 25.10.2024

<i>Q. No</i>	Note: Answers all questions, Assume suitable data if missing	Marks
1.	A helium balloon is at the same pressure and temperature as the surrounding air (1 atm, 20°C) and has a diameter of 3m. The weight of the plastic skin of the balloon is negligible. How much payload the balloon can lift? ($R = 8.2 \times 10^{-5} \text{ m}^3 \cdot \text{atm/mol} \cdot \text{K}$)	5
2.	Classify the various pressure measuring instrument. Find an expression for the pressure measurement using U tube manometer.	5
3.	Write the physical significance of Reynolds number? What are potential and inviscid flow?	3+2=5
4.	Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm ² and with a mean velocity of 2.0 m/s. Find the total head or the total energy per unit weight of the water at a cross-section, which is 5 m above the datum line.	5

B.Tech.

(SEM III) ODD SEMESTER EXAMINATION 2024-25
CHEMICAL ENGINEERING FLUID MECHANICS

[TIME: 3 hrs.]

[Max. Marks: 70]

(Note: Attempt All Questions. Assume suitable data if missing).

Q1. Attempt all parts

- | | Marks |
|---|-------|
| (a) What do you understand from fluid statics and fluid dynamics? | 3.5 |
| (b) Define specific gravity and viscosity of fluid. | 3.5 |
| (c) Derive the following equations of fluid statics for the non-vertical directions (say a) : | 3.5 |

$$\frac{dP}{da} = -\rho g \cos\theta$$

OR

- A cylindrical oil storage tank is 25 m deep and contains an oil of density 30 kg/m³. Its top is open to atmosphere. What is the gauge pressure at the bottom of this tank?
- (d) With neat sketch, briefly describe the mercury barometer. 3.5

OR

A block of steel floats at the mercury-water interface such that the a and b are the depth of block in mercury and water, respectively. What will be the ratio of a and b. Take specific gravity of steel block as 7.85.

Q2. Attempt all parts

- (a) Describe the following for the deformation of fluids 7
- Translation
 - Rotation
 - Linear strain
 - shear strain.

OR

Derive Euler's Equation of motion and obtain the Bernoulli Equation also from Eulers Equation accordingly.

- (b) The water is flowing through a pipe having diameters of 20 cm and 10 cm at sections 1 and 2, respectively. The rate of flow through pipe is 35 liters/sec. The section 1 is 6 m above datum and section 2 is 4 m above datum as shown in figure. If the pressure at section 1 is 39.24 N/m². Find the intensity of pressure at section 2. (density of water=1000kg/m³) 7

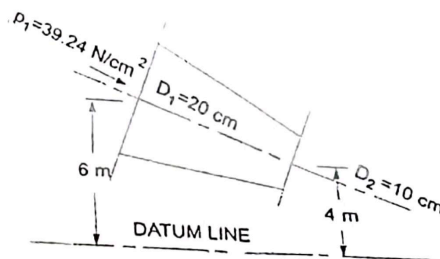


Figure 1

3. Attempt all parts

- (a) Write the common π groups and their physical significances. 7

OR

What is similitude and modeling? Explain the concept of geometric and dynamic similitude.

- (b) The drag characteristics of a blimp 5 m in diameter and 60 m long are to be studied in a wind tunnel. If the speed of the blimp through still air is 10 m/s, and if a 1/10 scale model is to be tested, what airspeed in the wind tunnel is needed for dynamically similar conditions? Assume the same air pressure and temperature for both model and prototype. 7

4. Attempt all parts

- (a) What is Orifice Meter? Develop an expression for the rate of flow or the discharge through it. 7

OR

Find the maximum and average velocity from the following expression of velocity profile of a fully developed laminar flow through a circular pipe:

$$u(r) = -\frac{R^2}{4\mu} \left(\frac{dP}{dx}\right) \left(1 - \frac{r^2}{R^2}\right)$$

- (b) An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$. (Sp. Gravity of mercury = 13.6). 7

5. Attempt all parts

- (a) Compare/write the characteristics of positive displacement pump and centrifugal pump. What is priming of pump? 7

OR

An agitated vessel 6 ft (1.83 m) in diameter contains a six-blade straight-blade turbine 2 ft (0.61m) in diameter, set one impeller diameter above the vessel floor and rotating at 80 r/min. It is proposed to use this vessel for neutralizing a dilute aqueous solution of NaOH at 70°F with a stoichiometrically equivalent quantity of concentrated nitric acid (HNO₃). The final depth of the liquid in the vessel is to be 6 ft (1.83 m). Assuming that all the acid is added to the vessel at one time, how long will it take for the neutralization to be complete?

- (b) Briefly describe (i) Piston Pump (ii) Plunger Pump (iii) Gear Pump 7

CO-BL Mapping of the Question Paper

Odd Semester Examination 2024-25			
Subject Code: ICH 302			
Subject Name: Chemical Engineering Fluid Mechanics			
Q. No.	Marks	CO	BL
1(a)	3.5	1	1
1(b)	3.5	1	2
1(c)	3.5	1	3
1(d)	3.5	1	4
2(a)	7	2	2
2(b)	7	2	3
3(a)	7	3	3
3(b)	7	3	4
4(a)	7	4	4
4(b)	7	4	3
5(a)	7	5	4
5(b)	7	5	3