7. A horizontal pipeline 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water in the tank is 8 m above the centre of the pipe. Considering all the losses determine the rate of flow. Take the coefficient of friction f=0.01 for both sections. Refer Fig. 2.

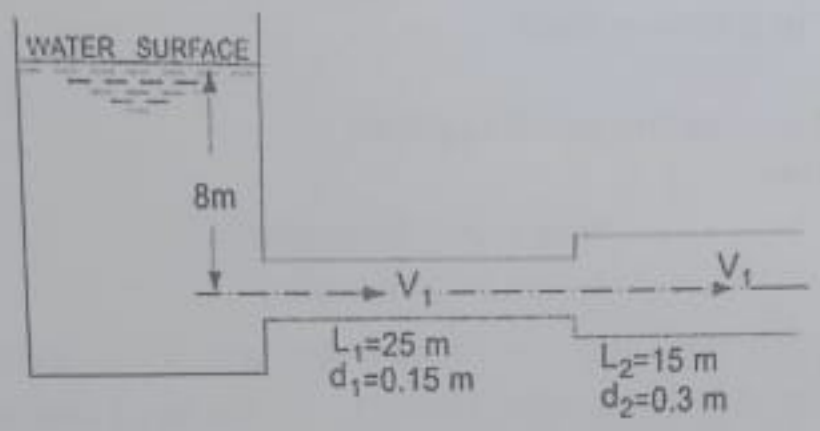

Fig. 2

8. The force required to tow a 1:30 scale model of a motorboat in a lake at a speed of 2 m/sec is 0.5 N. Assuming that the viscous resistance due to water and air is negligible in comparison with the wave resistance, calculate the corresponding speed of the prototype for dynamically similar conditions. What would be the force required to propel the prototype at that velocity in the same lake?

9.a) A packed bed of spherical particles of diameter 50 μm and density 4000 kg/m^3 is fluidized using air at 870°C and pressure 2.76 x10^4 N/m^2. The packed bed density is 1440 kg/m^3 and superficial air velocity is 0.3 m/sec. Calculate pressure drop using Ergun's equation. Viscosity of air 1.81 × 10^{-5} kg/m sec.

OR

9.b) Catalyst pellets 5 mm in diameter are to be fluidized with 45000 kg/hr of water with a density of 985 kg/m^3 and viscosity of 0.6x10^{-3} kg/msec in a vertical cylindrical vessel. The density of the catalyst particles is 1760 kg/m^3 and their sphericity is 0.86. Calculate the minimum fluidization velocity to fluidize the catalyst pellets. The void space of the bed is 0.45.

10.a) Write a short note on the following:

(i) Cavitation
(ii) Priming
(iii) Net Positive Suction Head

OR

10.b) Explain the material of construction and working principle of a reciprocating pump with a neat sketch.

⇔⇔⇔ C/L/TX ⇔⇔⇔

C/L/TX

Reg. No: 23BCE0051

Final Assessment Test – November 2024

VIT Vellore Institute of Technology

Course: BCHE205L - Momentum Transfer

Class NBR(s): 2660

Slot: D1+TD1

Time: Three Hours

Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

General Instructions:

a) Assume necessary and appropriate data if required

b) Moody chart is permitted

Answer ALL Questions

(10 X 10 = 100 Marks)

1. A square metal plate 1.8 m side and 1.8 mm thick weighing 60 N is to be lifted through a vertical gap of 30 mm of infinite extent. The oil in the gap has a specific gravity of 0.95 and a viscosity of 3 N.sec/m^2. If the metal plate is to be lifted at a constant speed of 0.12 m/sec, find the force and power required.

2. Consider a double-fluid manometer attached to an air pipe shown in Fig.1. If the specific gravity of one fluid is 13.55, determine the specific gravity of the other fluid for the indicated absolute pressure of air. Consider the atmospheric pressure to be 100 kPa.

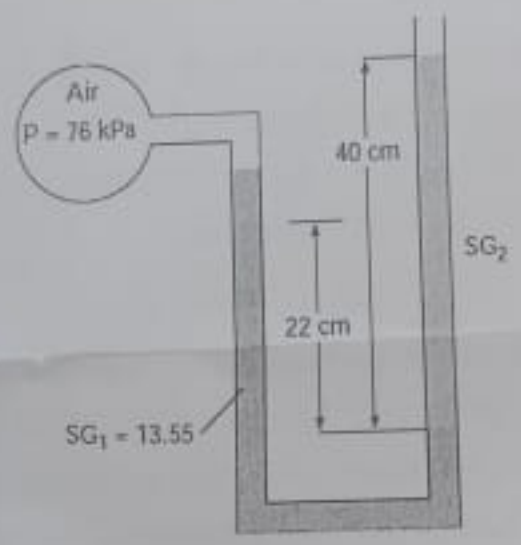

Fig.1

3. The velocity potential function (ϕ) is given by an expression

$$\varphi = -\frac{xy^3}{3} - x^2 + \frac{x^3y}{3} + y^2$$

(i) Find the velocity components in x and y direction

(ii) Show that ϕ represents a possible case of flow.

4. State and derive Bernoulli's theorem, mentioning the assumptions underlying it.

5. Derive the expression for a volumetric flow rate of fluid through a venturimeter.

6. A 40 cm x 25 cm rectangular duct is 200 m long. Air (ρ = 1.2 kg/m^3 and $\nu = 1.5 \times 10^{-5}$ m^2/sec) is blown through this duct at a velocity of 20 m/sec. Compute the pressure drop, head loss, and power required if the blower efficiency is 60%. Assume ε for the boundary as 0.05 mm.