Name: **Enrolment No:**	

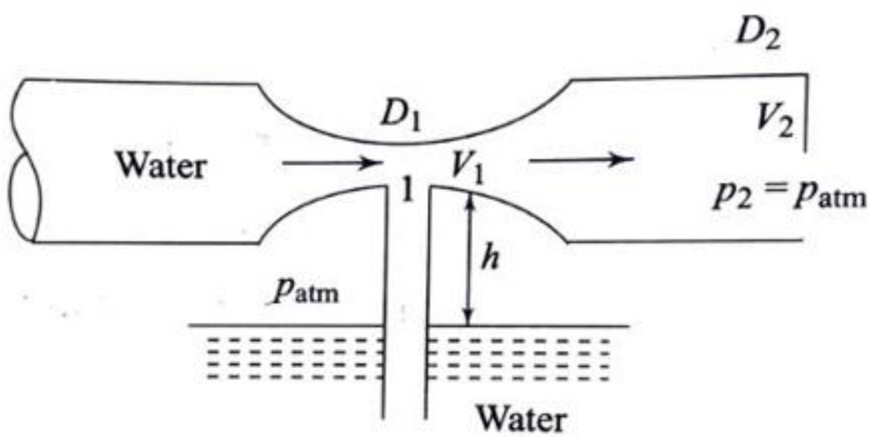
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, Dec 2023

Course: Momentum Transfer **Semester: III**
Program: B. Tech Chemical Engg. **Time: 3 hrs**
Course Code: CHCE 2003 **Max. Marks: 100**

Instructions: (1) Answer **ALL** questions
(2) Assume the appropriate value of missing data, if any.

SECTION A (20 M)			
S. No.		**Marks**	**CO**
Q1	Explain the concept of pump priming, NPSH and pump cavitation.	**4**	**CO1**
Q2	Explain the behaviour of non- Newtonian fluid, shear rate thinning and shear rate thicknening fluids with their examples.	**4**	**CO1**
Q3	What do you understand by major loss and minor loss.	**4**	**CO1**
Q4	Elaborate the advantages and limitations of venturi meter and orifice meter.	**4**	**CO1**
Q5	Discuss the static, dynamic, stagnation and piezometric pressure.	**4**	**CO1**
SECTION B (40 M)			
Q6	Two coaxial glass tubes forming an annulus with a small gap are immerged in water. The inner and outer radii of the annulus are r_2 and r_1 respectively. What is the capillary rise of water in the annulus if the surface tension of water is 0.073 N/m and contact angle is 30 degree. Derive the expression and solve the problem.	**10**	**CO3**
Q7	A nozzle is used to increase the velicity of fluid. A fluid whose density and velocity varies with the position in the pipeline. The velocity (u) and density (ρ) fields if the fluid through the nozzle is given by, $u = u_0\ e^{\left(-\frac{2x}{L}\right)}$ and $\rho = \rho_0\, e^{\left(-\frac{x}{L}\right)}$. Show that the rate of change of density in Lagrangian frame of reference is $\frac{-0.05u_0\ \rho_0}{L}$.	**10**	**CO2**
Q8	The velocity distribution for a fully developed laminar flow in a circular pipe of radius, R, is given by, $u = -\frac{R^2}{4\mu}\frac{dP}{dx}\left[1-\left(\frac{r}{R}\right)^2\right]$. Determine the expressions for total discharge and pressure drop through the pipe of length L. The terms have their usual meanings.	**10**	**CO3**

Q9	A metal plate 1.25 m × 1.25 m × 6 mm thick and weighing 90 N is placed midway in the 24 mm gap between the two vertical plane surfaces. The gap is filled with an oil of specific gravity 0.85 and dynamic viscosity 3.0 N.s/m^2. Determine the force required to lift the plate with a constant velocity of 0.15 m/s.	**10**	**CO2**
	SECTION C (40 M)		
Q10	An hydrocarbon oil (mol. wt. = 220; density= 1.8 gm / cc., and viscosity = 0.005 Pa.s) is beinh pumped from a storage tank at ground floor to the top of the distillation column of height 10 m at the rate of 2000 kg/min through a 5 cm inner diameter smooth pipe. The pump efficiency is 60%, calculate the pump power rwquirement. The losses of the pump can be taken as 1.5 kgf-m/kg.	**20**	**CO4**
Q11	A necked-down or venturi section of a pipe flow develops a low pressure which can be used to aspirate liquid upward from a reservoir as shown in Figure below. Develop an expression for the exit velocity V_2 which is just sufficient to cause the reservoir liquid to rise in the tube up to section 1. Consider the liquid originally flowing through the pipe and that to be pumped from the reservoir are same (neglect frictional losses). 	**20**	**CO4**