Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, Dec 2023

Course: Fluid Mechanics in Pet Engg. **Semester: III**
Program: B. Tech APEUP **Time: 3 hrs**
Course Code: PEAU 2005 **Max. Marks: 100**

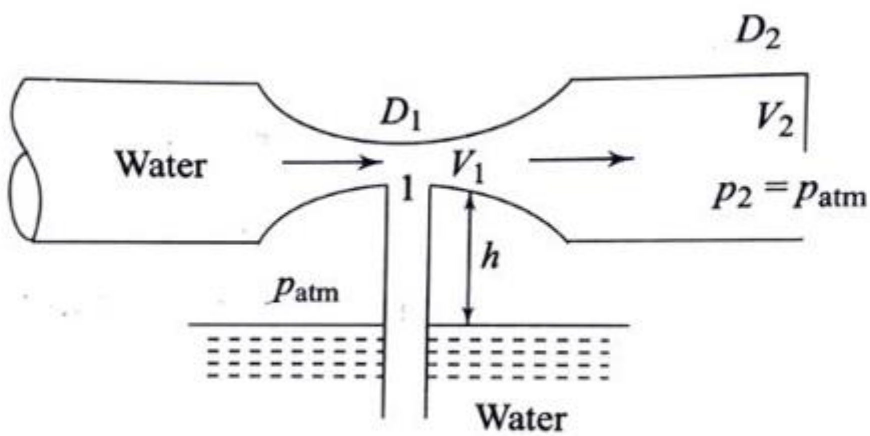
Instructions: (1) Answer **ALL** questions
(2) Assume the appropriate value of missing data, if any.

SECTION A (20 M)

S. No.		Marks	CO
Q1	Explain the concept of surface energy and surface tension.	**4**	**CO1**
Q2	Explain the behavior of pseudoplastic, dilatant, Newtonian and bingham plastics on a stress-deformation diagram.	**4**	**CO1**
Q3	Discuss form friction and skin friction.	**4**	**CO1**
Q4	Discuss the application of a venturi meter, orifice meter and pitot tube to determine the speed of fluid. Also, elaborate on their advantages and limitations.	**4**	**CO1**
Q5	Differentiate static, dynamic, stagnation and piezometric pressure.	**4**	**CO1**

SECTION B (40 M)

Q6	A spherical soap bubble of diameter d_1 coalesces with two other bubbles of diameter d_2 and d_3 to form a single bubble of diameter d_4 containing the same amount of air. Derive an analytical expression for d_4 as a function of d_1, d_2, the ambient pressure p_0 and the surface tension of the soap solution, σ.	**10**	**CO2**
Q7	A nozzle is used to increase the velocity of fluid. A fluid whose density and velocity vary with the position in the pipeline. The velocity (u) and density (ρ) fields of 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 the 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 $u = -\frac{R^2}{4\mu}\frac{dP}{dx}\left[1-\left(\frac{r}{R}\right)^2\right]$	**10**	**CO3**

	Determine the radial distance from the pipe axis at which the velocity equals the average velocity. The terms have their usual meanings.		
Q9	Examine the performance characteristic curves of centrifugal pumps, including the constant efficiency curve and the pump affinity laws. Elaborate on their practical applications in assessing pump performance and aiding in the selection process.	**10**	**CO3**
SECTION C (40 M)			
Q10	Calculate the power required and the pressure which should be developed by a pump of 70% efficiency to send 60 kg/min of sulphuric acid at 25°C from a tank at atmospheric pressure through 300 meters of 5cm inner diameter steel pipe to a tank of 2.0 kg/cm^2 pressure, where the level is 3 meters above that in the lower tank. The density and viscosity of the acid may be taken as 1.8 gm / cc., and 0.026 Pa.s, respectively.	**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**