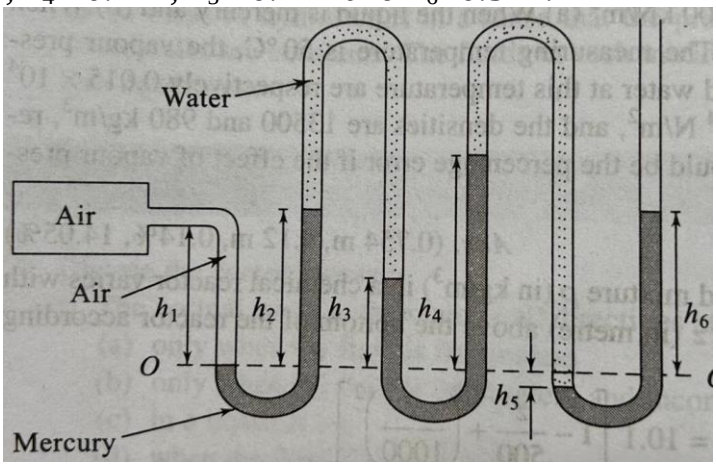
Name:

Enrolment No:

UPES
UNIVERSITY OF TOMORROW

Supplementary Examination, Dec 2023

Program Name: B. Tech APE GAS Engg. **Semester : III**
Course Name: Momentum Transfer **Time : 3 hrs.**
Course Code: CHCE 2003 **Max. Marks: 100**
Nos. of page(s): 2
Instructions: Attempt all questions

S. No.		Marks	CO
Q 1	Two different liquids are flowing through two different pipes. The diameter of the first pipe is 40% less than the diameter of the second pipe. In the first pipe the flow is laminar with the average velocity $u_{1,}$ whereas in the second pipe flow is turbulent with the average velocity 80% more than the average velocity in the first pipe. Find the ratio of discharge in two pipes.	**10**	**1**
Q 2	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/m2. Determine the force required to lift the plate with a constant velocity of 0.15 m/s.	**10**	**2**
Q3	A multitube manometer using water and mercury is used to measure the pressure of air in a vessel as shown in the Figure below. Calculate the gauge pressure in the vessel for a given value of heights, h_1=0.4 m, h_2=0.5 m, h_3= 0.3 m, h_4= 0.7 m, h_5 =0.1 m and h_6=0.5 m. 	**10**	**2**

Q 4	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 radial distance from the pipe axis at which the velocity equals the average velocity. The terms have their usual meanings.	**10**	**3**
Q 5	A spherical soap bubble of diameter d_1 coalesces with another bubble of diameter d_2 to form a single bubble of diameter d_3 containing the same amount of air. Derive an analytical expression for d_3 as a function of d_1, d_2, the ambient pressure p_0 and the surface tension soap solution, σ. If d_1 = 20mm, d_2= 40 mm p_0= 1atm and σ = 0.09 N/m. Find the value of d_3.	**10**	**3**
Q6	Derive the general continuity equation in 3 dimensions cartesian coordinate system for the compressible fluid.	**10**	**3**
Q7	A hydrocarbon oil (mol. wt. = 220; density = 1.8 gm / cc., and viscosity = 0.005 Pa.s) is being pumped from a storage tank at the 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 requirement. The losses of the pump can be taken as 1.5 kgf-m/kg.	**20**	**4**
Q8	Two coaxial glass tubes forming an annulus with a small gap are immerged in water. The inner and outer radii of the annulus are r2 and r1 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.	**20**	**4**