Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

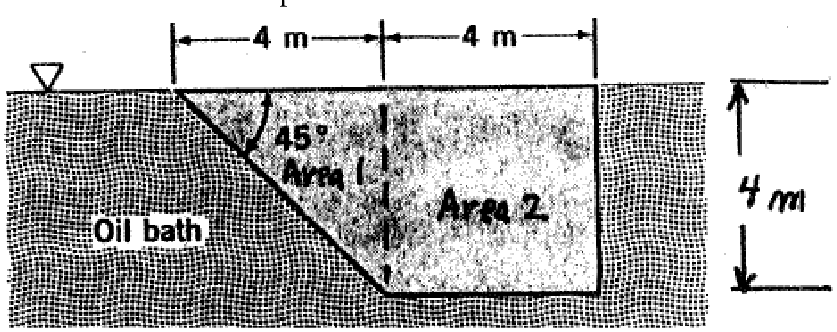
End Semester Examination, December 2023

Course: **Fluid Mechanics** **Semester: III**
Program: **B.Tech ME, ADE, Mechatronics** **Time: 03 hrs**
Course Code: **MECH2023** **Max. Marks: 100**

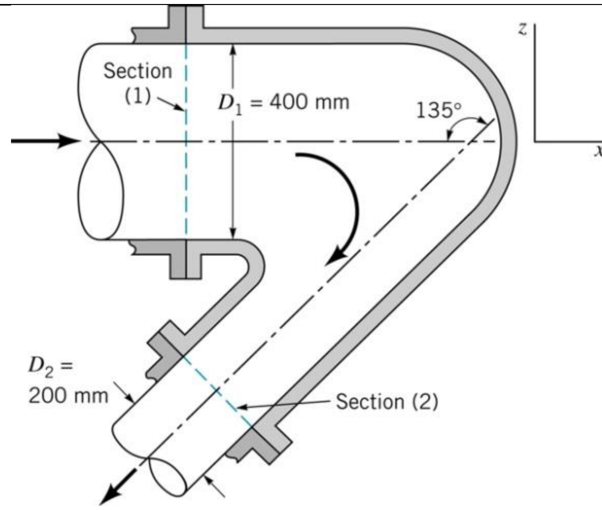
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Discuss the effect of temperature on viscosity of liquids and gases in general.	**4**	**CO1**
Q 2	A hissing sound is heard when a garden hose (through which water is flowing) is pinched. Analyze and explain the phenomenon.	**4**	**CO2**
Q 3	Differentiate between streamline, streakline and pathline concisely.	**4**	**CO2**
Q 4	Golf balls have dimples. Discuss the reason.	**4**	**CO3**
Q 5	Discuss the development of boundary layer over a flat plate and its features with a suitable sketch. How does local shear vary over the plate?	**4**	**CO3**

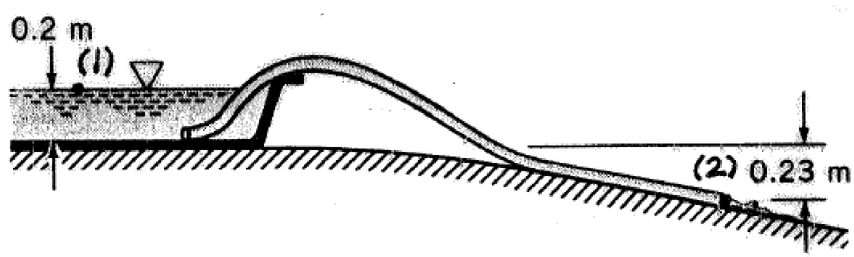
SECTION B
(4Qx10M= 40 Marks)

Q 6	A two dimensional, incompressible flow is given by $u = -y, v = x$. Determine the equation for streamlines, draw them, and also get the equation of streamline that passes through 'x=10, y=0' point.	**10**	**CO2**
Q 7	A vertical plane area having the shape shown in Fig. below is immersed in an oil bath (specific gravity = 0.89). Determine the magnitude of the resultant force acting on one side of the area as a result of the oil. Also determine the center of pressure.  	**10**	**CO1**

Q 8	Air ($\rho = 1.23\ kg/m^3$, $\mu = 1.79x10^{-5} Ns/m^2$) flows through a 3 mm diameter tube with an average speed of 60 m/s. (a) Assuming that precautions are taken to eliminate any disturbances and flow remains laminar, determine the pressure drop in 0.1 m length of tube (b) Repeat the calculation if flow is turbulent and roughness $\epsilon = 0.0015\ mm$. Moody's chart is given at the end.	**10**	**CO4**
Q 9	At a sudden contraction in a pipe the diameter changes from D_1 to D_2. The pressure drop, Δp, which develops across the contraction is a function of D_1 and D_2, as well as the velocity, V, in the larger pipe, and the fluid density, ρ, and viscosity, μ. Use D_1, V, and μ as repeating variables to determine a suitable set of dimensionless parameters. Why would it be incorrect to include the velocity in the smaller pipe as an additional variable? **OR** It is desired to determine the drag on a very small body when placed in water flowing at 10 m/s. Since, the body is small, experiment is done using air flow over a larger model of scale 50. Calculate the flow velocity of air for the model. The measured drag on model is 1 N. Calculate the drag on the small body assuming similarity. Kinematic viscosity of water, $\nu_w = 1.12x10^{-6} m^2/s$ Kinematic viscosity of air, $\nu_a = 1.46x10^{-5} m^2/s$ Density of air, $\rho_a = 1.2\ kg/m^3$	**10**	**CO3**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	(a) **(14 Marks)** A converging elbow turns water through an angle of 135° in a vertical plane. The flow cross section diameter is 400 mm at the elbow inlet, section (1), and 200 mm at the elbow outlet, section (2). The elbow flow passage volume is 0.2 m^3 between sections (1) and (2). The water volume flowrate is 0.4 m^3/s and the elbow inlet and outlet pressures are 150 kPa (gauge) and 90 kPa (gauge). The elbow mass is 12 kg. Calculate the horizontal (x direction) and vertical (z direction) anchoring forces required to hold the elbow in place.	**20**	**CO4**

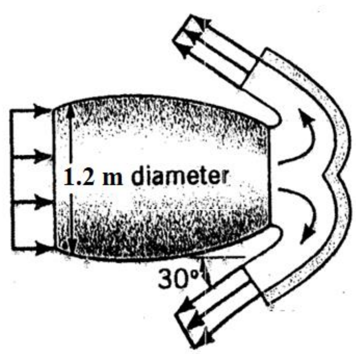


(b) **(6 Marks)** A smooth plastic, garden hose with an inside diameter of 20 mm is used to drain a pool of water as is shown in Fig. below. If viscous effects are neglected, what is the flowrate from the pool

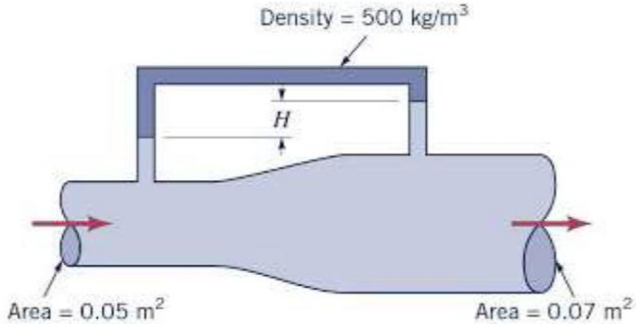


OR

(a) **(10 Marks)** Air flows into the jet engine at a rate of 130 kg/s and speed of 90 m/s. Upon landing, the engine exhaust exits through the reverse thrust mechanism with a speed of 270 m/s in the direction shown. Determine the reverse thrust applied by the engine to the airplane. Density of air is 1.2 kg/m3. Engine diameter is 1.2 m.



(b) **(10 Marks)** Water flows through the pipe with negligible viscous effect. Determine the manometer reading H if flow rate is 0.4 m^3/s and

	density of manometer fluid is 500 kg/m^3. Inlet and outlet pipe areas are 0.05 m^2 and 0.07 m^2, respectively. 		
Q 11	Consider steady, laminar flow of an incompressible fluid between two horizontal, fixed parallel plates. Derive the velocity distribution, volumetric flow rate and mean velocity as a function of pressure gradient.	**20**	**CO2**