Name: **Enrolment No:**	UPES

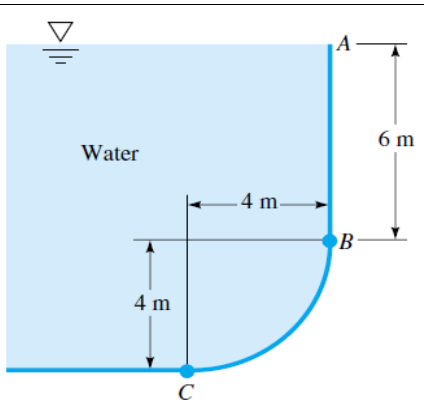
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, Dec 2021

Course: Fluid Mechanics (MECH 2023) **Semester: III**
Programme: B.Tech ADE **Time: 3 hrs**
Max. Marks: 100

Instructions: All the questions are compulsory. Please assume suitable data if missing.

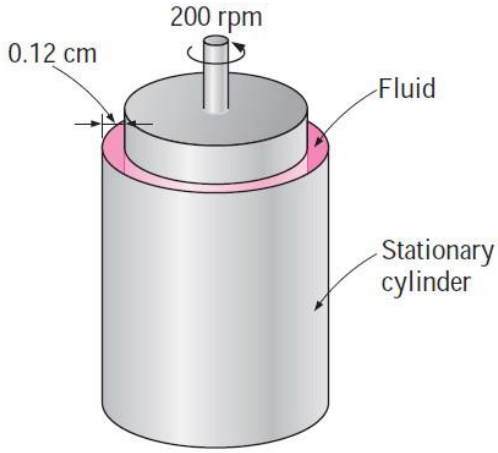
Section-A (5x4)

Q. No	Statement	Marks	CO
Q.1	Differentiate between streamlined and bluff bodies.	**4**	**CO1**
Q.2	Enlist the limitations of Bernoulli's theorem.	**4**	**CO2**
Q.3	"The existence of stream function is the compliance of the flow to be continuous". Justify the statement.	**4**	**CO1**
Q.4	Discuss the stability criteria for floating and completely submerged bodies.	**4**	**CO1**
Q.5	Explain the term Laminar sublayer.	**4**	**CO1**
	Section-B (4x10)		
Q.6	Derive Euler's equation of motion along a streamline and integrate it to obtain Bernoulli's equation.	**10**	**CO2**
Q.7	For a two-dimensional fluid flow the velocity function is given by the expression $Ø = x^2-y^2$. i. Determine the velocity component in x and y directions. ii. Show that the velocity components satisfy the conditions of flow continuity and irrotationality. iii. Determine stream function and flow rate between the streamlines (2, 0) and (2, 2).	**10**	**CO2**
Q.8	For the following velocity profile in the boundary layer on a flat plate, calculate the displacement and momentum thickness in terms of the nominal boundary layer thickness δ. $\mathbf{u/U = 2\eta - 2\eta^3 + \eta^4}$ Where $\boldsymbol{\eta=y/\delta}$	**10**	**CO4**
Q.9	The tank in figure is 3 m wide into the paper. Neglecting atmospheric pressure, compute the hydrostatic (*a*) horizontal force on BC, (*b*) vertical force on BC, (*c*) resultant force on *BC*	**10**	**CO3**

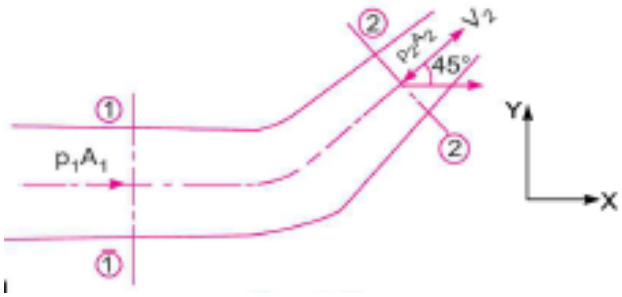


OR

The viscosity of a fluid is to be measured by a viscometer constructed of two 75-cm-long concentric cylinders as shown in Figure. The outer diameter of the inner cylinder is 15 cm, and the gap between the two cylinders is 0.12 cm. The inner cylinder is rotated at 200 rpm, and the torque is measured to be 0.8 N m. Determine the viscosity of the fluid.



Section-C (2x20)

Q.10	A 45 degree reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 600 mm and 300 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at the inlet to the bend is 8.829 N/cm^2 and rate of flow of water is 600 litres/s. 	**20**	**CO3**

Q.11	Establish relationship between shear stress and pressure distribution for laminar flow between two fixed parallel plates. Also, prove that for a steady laminar flow between two fixed parallel plates, the velocity distribution across a section is parabolic and that the average velocity is $2/3^{rd}$ of the maximum velocity. **(20 marks)** **OR** a) A truck having a projected area of 6.5 m^2 travelling at 70 km/hr has a total resistance of 2000 N. Of this 20% is due to the rolling friction and 10% due to surface friction. The rest is due to drag friction. Make calculations for coefficient of form drag. **(8 marks)** b) A passenger car with frontal projected area of 1.5 m^2 travels at 56 km/hr. Determine the power required to overcome wind resistance if the drag coefficient of car is 0.4. For the same power extended in overcoming resistance, find possible percentage change in speed if drag coefficient is reduced to 0.32 by streamlining the car body. **(12 marks)**	**20**	**CO4**