U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

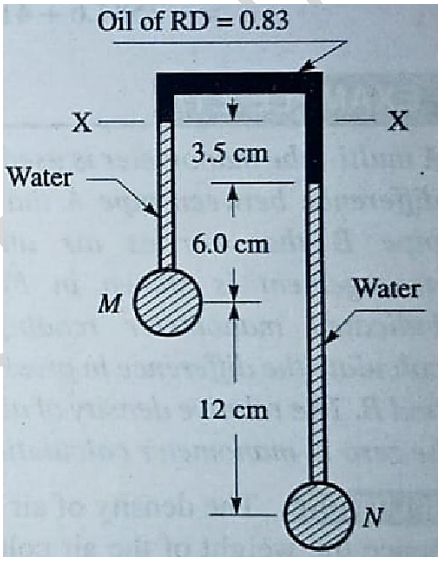
Autonomous Institute Affiliated to VTU

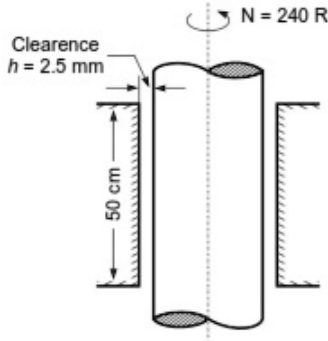
April 2024 Semester End Main Examinations

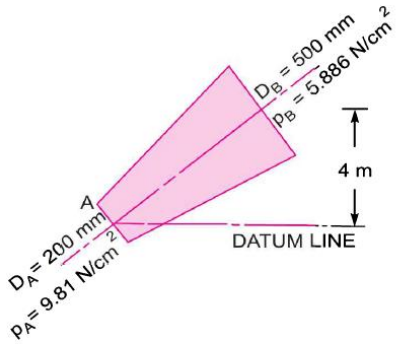
Programme: B.E. **Semester: III**
Branch: Civil Engineering **Duration: 3 hrs.**
Course Code: 23CV3PCFME / 22CV3PCFME **Max Marks: 100**
Course: FLUID MECHANICS

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		Define the following terms with SI Units: i) weight density ii) Specific volume and iii) bulk modulus.	CO 1	PO1	6
	b)		A 90 N rectangular solid block slides down a 30° inclined plane. The plane is lubricated by a 3 mm thick film of oil of relative density 0.90 and viscosity 8.0 poise. If the contact area is 0.3 m^2, estimate the terminal velocity of the block.	CO 1	PO1	8
	c)		For the manometer shown in Fig.1, estimate the pressure difference between points M and N. The pipes M and N carries oil of relative density 0.83.  Fig. 1	CO 1	PO1	6
			OR			
2	a)		Derive the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure.	CO 1	PO1	6

		b)	A cylindrical shaft of 90 mm diameter rotates about a vertical axis inside a fixed cylindrical tube of length 50 cm and 95 mm internal diameter as shown in Fig. 2. If the space between the tube and the shaft is filled by a lubricant of dynamic viscosity 2.0 poise, determine the power required to overcome the viscous resistance when the shaft rotates at a speed of 240 rpm.  Fig. 2	***CO 1***	***PO1***	**8**
		c)	Calculate the capillary effect in mm in a glass tube 3 mm in diameter when immersed in (i) water and (ii) mercury. Both the liquids are at 20°C and the values of the surface tensions for water and mercury at 20°C in contact with air are respectively 0.0736 N/m and 0.51 N/m. Contact angle for water = 0° and for mercury = 130°.	***CO 1***	***PO1***	**6**
			UNIT - II			
	3	a)	Derive an expression for the force exerted on a vertical plane fully submerged in a static liquid. Also, locate the position of the centre of pressure.	***CO 1***	***PO1***	**6**
		b)	A cubical tank has sides of 1.5 m. It contains water in the lower 0.6 m depth. The upper remaining part is filled with oil of relative density 0.9. For one of the vertical sides of the tank (i) draw the pressure diagram and (ii) determine the total pressure.	***CO 1***	***PO1***	**6**
		c)	A circular plate of diameter 0.75 m is immersed in a liquid of relative density 0.8 with its plane making an angle of 30^o with the horizontal. Centre of the plate is at a depth of 1.5 m below the free liquid surface. Calculate the total pressure on one side of the plate and the location of the centre of pressure.	***CO 1***	***PO1***	**8**
			UNIT - III			
	4	a)	With neat sketches, explain the terms path line and stream line in a fluid flow.	***CO 2***	***PO1***	**4**
		b)	Given that the velocity potential of a two-dimensional flow is $\phi = \frac{y^3}{3} - x^2y$. Derive the relevant stream function.	***CO 2***	***PO1***	**8**
		c)	Two velocity components of the flow are given in the following cases. Derive the third component such that they satisfy the continuity equation. (i) $u = x^3 + y^2 + 2z^2$; $v = -x^2y - yz - xy$; (ii) $u = \log(y^2 + z^2)$; $v = \log(x^2 + z^2)$	***CO 2***	***PO1***	**8**

			UNIT - IV			
	5	a)	Derive an expression for rate of flow through a venturi meter connected to a vertical pipe with upward flow.	***CO 2***	***PO1***	**6**
		b)	Pressure difference between the static and stagnation tubes of a Prandtl pitot tube placed at the centre of a 200 mm pipe line is 40 mm of water. Discharge of water through the pipe is 1365 litres/minute. Assume the average velocity through the pipe as 0.83 times the centre velocity. Calculate the coefficient of the Pitot tube.	***CO 2***	***PO1***	**6**
		c)	The maximum flow through a rectangular flume 1.8 m wide and 1.2 m deep is 1.65 m^3/s. It is proposed to install a suppressed sharp crested rectangular weir across the flume to measure the flow. Determine the maximum height at which the weir crest can be placed in order that water may not overflow the sides of the flume. Assume coefficient of discharge $C_D = 0.6$.	***CO 2***	***PO1***	**8**
			OR			
	6	a)	With a neat sketch, derive an expression for discharge over a triangular notch/weir installed in an open channel.	***CO 2***	***PO1***	**6**
		b)	A discharge of 100 litres/second is to be measured by a triangular notch of vertex angle 60^o. Assume C_D of the notch as 0.58. (i) Calculate the head over the notch for the given discharge. (ii) If the accuracy of reading the head is 1 mm, estimate the error that can be expected in the discharge.	***CO 2***	***PO1***	**6**
		c)	A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm at A to 500 mm at B, which is 4 meters above A, as shown in Fig. 3. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively, and the discharge is 200 litres/second, determine the loss of head and the direction of flow.  Fig. 3	***CO 2***	***PO1***	**8**
			UNIT - V			
	7	a)	Illustrate the variation of Hydraulic Grade Line and Total Energy Line for flow in a straight tapering pipe inclined at a slope of 1 in 100.	***CO 3***	***PO1***	**4**
		a)	For a town water supply, a main pipeline of diameter 0.4 m is required. As pipes more than 0.35 m diameter are not readily available, two parallel pipes of the same diameter were used for water supply. If the total discharge in the parallel pipes is to be the same as in the single main pipe, determine the diameter of the parallel pipes. Assume the coefficient of friction to be the same for all the pipes.	***CO 3***	***PO2***	**8**

		b)	A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. The pressure intensities in the larger and smaller pipe is given as 13.734 N/cm^2 and 11.772 N/cm^2 respectively. Determine the loss of head due to the sudden contraction and rate of flow. Assume C_c for the contraction as 0.62.	***CO 3***	***PO1***	**8**

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