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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

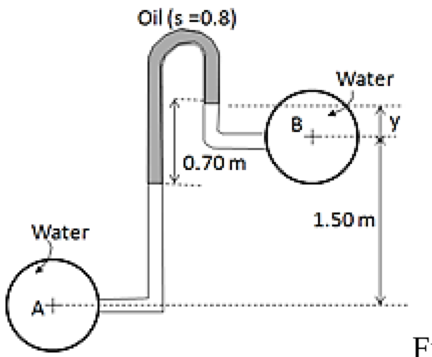
Programme: B.E. **Semester: III**

Branch: Civil Engineering **Duration: 3 hrs.**

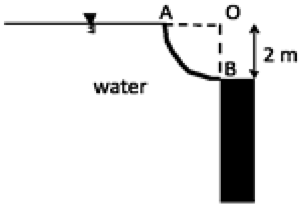
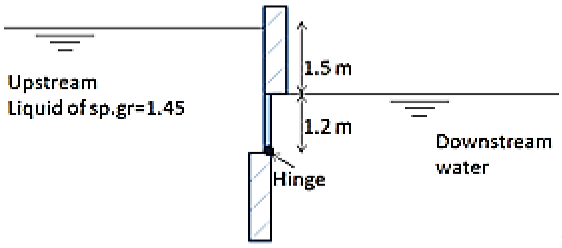
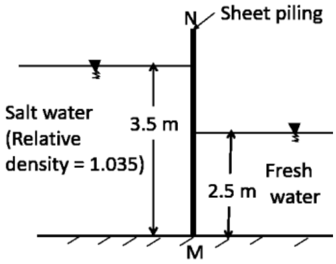
Course Code:19CV3PCMOF **Max Marks: 100**

Course: Mechanics of Fluids

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

		UNIT - I	***CO***	***PO***	**Marks**
1	a)	Define viscosity and state Newton's law of viscosity. Velocity distribution for flow over a flat plate is given by $u= (3/4)\, y - y^2$, where u is the velocity (m/s) at y m above the plate. Determine the shear stress at y = 0.15 m. Dynamic viscosity of the fluid is 8.6 poise.	*CO1*	*PO 1*	**10**
	b)	A certain fluid of specific gravity 0.8 flows upward through a vertical pipe. *A* and *B* are two points on the pipe, *B* being 0.3 m higher than *A*. A U-tube mercury manometer is connected at points *A* and *B*. If the difference in pressure between *A* and *B* is 5 kPa, determine the difference in heights of the mercury column in the manometer.	*CO1*	*PO1*	**10**
		OR			
2	a)	Estimate the difference in pressure between the points *A* and *B* in a water pipe line shown in Fig. 1  Fig. 1	*CO1*	*PO1*	**10**
	b)	The diameter of a small piston and a large piston of a hydraulic jack are 3 cm and 10 cm respectively. A force of 80 N is applied on the small piston. Mass density of the liquid in the jack is 1000 kg/m^3.	*CO1*	*PO1*	**10**

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.

			Compute the load lifted by the large piston when i) the pistons are at the same level ii) small piston is 40 cm above the large piston.			
			UNIT - II			
	3	a)	Fig. 2 shows a gate *AB* having a quadrant shape of radius 2 m. Determine the magnitude and direction of the resultant force due to water per metre length of the gate.  Fig. 2	*CO2*	*PO1*	**10**
		b)	A vertical sluice gate is used to cover an opening in a dam. The opening is 2 m wide and 1.2 m high. On the upstream side of the gate, the liquid of specific gravity 1.45 lies up to a height of 1.5 m above the top of the gate, whereas on the downstream side water is available up to a height touching the top of the gate (Fig. 3). Compute the resultant force acting on the gate and the centre of pressure. Assume that the gate is hinged at the bottom.  Fig. 3	*CO2*	*PO2*	**10**
			OR			
	4	a)	A sheet pile *MN* holds fresh water and salt water (relative density = 1.035) on either sides of it as shown in Fig. 4. Determine the moment due to the resultant force about the base *M*. Assume width of the sheet pile as 1 m.  Fig. 4	*CO2*	*PO2*	**10**
		b)	A cylindrical gate of diameter 2.5 m retains two liquids on either side of it as shown in Fig. 5. Estimate the magnitude and direction of the resultant force acting per unit length of the gate.	*CO2*	*PO1*	**10**

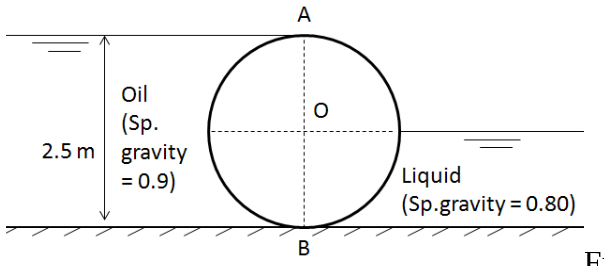


Fig. 5

			UNIT - III			
	5	a)	A stream function in a two-dimensional flow is $\psi = 2xy$. Show that the flow is irrotational and determine the corresponding velocity potential Φ.	*CO3*	*PO1*	**10**
		b)	Differentiate between local and convective accelerations. A steady two-dimensional flow has the following velocity fields $u = 2x + 3y - 5$ and $v = 5x - 2y - 9$. Determine the acceleration at the point (1,1).	*CO3*	*PO1*	**10**
			OR			
	6	a)	For a two-dimensional flow, velocity potential is given by $\Phi = \frac{3}{2}(y^2 - x^2)$. Check whether it represents a possible case of fluid flow. If yes, determine the velocity components in the *x* and *y* directions. Also, determine the value of velocity at points (1,3) and (4,4).	*CO3*	*PO1*	**10**
		b)	A steady, incompressible, two-dimensional velocity field is given by $u = \frac{y^3}{3} + 2x - x^2y$ and $= xy^2 - 2y - \frac{x^3}{3}$. Analyse whether this represents an irrotational flow. If so, determine the velocity potential function which can represent this flow.	*CO3*	*PO2*	**10**
			UNIT - IV			
	7	a)	With a neat sketch explain the working principle of a pitot tube. In a Prandtl's pitot tube the stagnation pressure is 3 kPa and the static pressure is -3 kPa (gauge). The fluid is air of mass density 1.20 kg/m^3. Calculate the velocity of flow by taking the instrument coefficient as 0.98.	*CO4*	*PO1*	**10**
		b)	With a neat sketch, derive the expression for discharge through a venturimeter connected to a vertical pipe where flow is in the upward direction.	*CO4*	*PO1*	**10**
			OR			
	8	a)	An oil of relative density 0.90 flows through a vertical pipe of diameter 20 cm. The flow is measured by a 20 cm x 10 cm venturimeter. The throat is 30 cm above the inlet section. A differential U-tube manometer containing mercury is connected to the throat and the inlet. Assume the coefficient of discharge as 0.99.	*CO4*	*PO1*	**10**

			Determine (i) Discharge through the pipe for a manometer reading of 9 cm. (ii) Manometer reading for a flow of 50 litres/second in the pipe.			
		b)	State Bernoulli's principle. Derive the expression for Bernoulli's principle for the steady, incompressible flow of an ideal fluid.	*CO4*	*PO1*	**10**
			UNIT - V			
	9	a)	An old 3 km pipe line of a city water supply consists of pipes of four different sizes, namely 30 cm for the first 500 m, 25 cm for the next 1000 m, 20 cm for the next 1000 m and 15 cm for the remaining length. The pipe line needs to be replaced by a new pipe of same material, but uniform diameter over the entire 3 km stretch. Neglecting the minor losses, calculate the diameter of the pipe required to replace the existing compound pipe.	*CO4*	*PO2*	**10**
		b)	A rectangular weir 36 m long is divided into 12 equal bays by vertical posts, each 60 cm wide. Calculate the discharge over the weir if the head over the crest is 1.20 m. Ignore the velocity of approach. Assume coefficient of discharge as 0.70.	*CO4*	*PO1*	**10**
			OR			
	10	a)	A pipeline carrying water has a diameter of 0.5 m and is 2.0 km long. Total head loss in the pipe is 15 m of water. (i) Estimate the discharge through the pipe. (ii) To increase the delivery, another pipe of same diameter is connected parallel to the first pipeline in the second half of its length. Calculate the increase in discharge if the total head loss remains 15 m. Assume Darcy's friction factor f = 0.02 for all the pipes.	*CO4*	*PO2*	**10**
		b)	A discharge of 100 litres per second is to be measured by a triangular notch of vertex angle 60^o. Coefficient of discharge of the notch is 0.58. (i) Estimate the corresponding head over the vertex of the notch. (ii) If the accuracy of reading the head is 1 mm, estimate the error in discharge that can be expected at this level.	*CO4*	*PO1*	**10**

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