U.S.N.										

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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

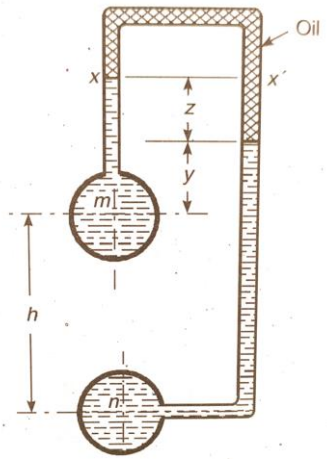
Programme: B.E. **Semester: III**

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.

		UNIT - I	CO	PO	Marks
1	a)	Water fills the vessels and a portion of the connecting tube shown in Fig. 1. i) If the manometric liquid is oil of specific gravity 0.9, determine the difference in pressure intensity between *m* and *n* when h = 1.25 m and z = 0.3 m. ii) In the same figure, if instead of water is filled in the vessels *m* and *n*, and the manometric liquid used has a specific gravity of 1.6, calculate the difference in pressure intensity between *m* and *n* when h = 0.6 m and z = 1.0 m.  Fig. 1	*CO1*	*PO1*	**10**
	b)	The diameter of large and small piston of a Hydraulic jack are 10 cm and 3 cm respective. Density of the liquid in the jack is given as 1000 kg/m^3. A force of 80 N is applied on the small piston. Determine the load lifted by the large piston when (i) Both piston are at the same level. (ii) Small piston is 40cm above the large piston.	*CO1*	*PO1*	**10**
		OR			

	2	a)	State Newton's law of viscosity. Velocity profile of a fluid over a plate is parabolic and is represented using $u = -20y^2 + 12y$. Kinematic viscosity of the fluid is 9.4 x 10^{-4} m^2/s and specific gravity is 0.9. Calculate the velocity gradients and shear stresses at a distance of 0, 10 and 20 cm from the plate.	*CO1*	*PO1*	**10**
		b)	Define hydrostatic pressure. Show that in a static fluid mass, the hydrostatic pressure varies only along the vertical direction.	*CO1*	*PO1*	**10**
			UNIT - II			
	3	a)	Define the terms total pressure and centre of pressure. For a flat inclined lamina fully submerged in a liquid, show that the total pressure acts always below the centroid of the lamina.	*CO1*	*PO1*	**10**
		b)	A rectangular plane surface 2 m wide and 3 m deep lies in water in such a way that its plane makes an angle of 30^o with the free water surface. Determine the total pressure and position of the centre of pressure when the upper edge of the plate is (i) 1.5 m below the free water surface (ii) at the free water surface.	*CO1*	*PO1*	**10**
			OR			
	4	a)	A circular gate on a vertical wall has a diameter of 4 m. The water surface on the upstream side is 8 m above the top edge of the gate, and on the downstream side is 1 m above the top edge of the gate. Determine the forces acting on the two sides of the gate, the resultant force acting on the gate and the position of the resultant.	*CO1*	*PO1*	**10**
		b)	A square tank of 1 m side contains water up to a height of 0.5 m above the base. An immiscible liquid of specific gravity 0.8 is filled on the top of water up to 1 m height. Calculate (i) total pressure on one side of the tank (ii) position of centre of pressure for one side of the tank.	*CO1*	*PO1*	**10**
			UNIT - III			
	5	a)	The Following cases represent the two velocity components. Determine the third component of velocity such that they satisfy the continuity equation. (i) $u = x^2 + y^2$, $v = xy^2 - yz^2 + xy$ (ii) $v = 2y^2$, $w = 2xyz$	*CO2*	*PO1*	**10**
		b)	Velocity potential for a two-dimensional flow is given by $$\phi = (x^2 - y^2) + 3xy$$ i) Calculate the stream function ii) Determine the flow rate between the streamlines passing through the points (1,1) and (1,2)	*CO2*	*PO1*	**10**

			OR			
	6	a)	Derive the expression for continuity equation for a steady, incompressible, three-dimensional flow in Cartesian coordinate system.	*CO2*	*PO1*	**10**
		b)	Water flows through a pipe *AB* of 1.2 m diameter at 3 m/s, and then passes through a pipe *BC* of 1.5 m diameter. At *C*, the pipe branches into two. The branch *CD* is 0.8 m in diameter and carries one third of the flow in *AB* and flow velocity in branch *CE* is 2.5 m/s. Determine the volume rate of flow in *AB*, velocity in *BC* and *CD*, and diameter of *CE*.	*CO2*	*PO1*	**10**
			UNIT - IV			
	7	a)	State Bernoulli's Principle. Derive the expression for Bernoulli's principle for a steady, incompressible, laminar flow along a streamline.	*CO2*	*PO1*	**10**
		b)	A pipeline carrying oil of specific gravity 0.87 changes in diameter from 200 mm at a section *A* to 500 mm diameter at a section *B*, which is 4 m above *A*. The pressure at *A* and *B* are 9.81 N/cm^2 and 5.88 N/cm^2 respectively, for a discharge of 200 lit/sec. Determine the total loss of head and the direction of flow.	*CO2*	*PO2*	**10**
			OR			
	8	a)	Derive the expression for discharge over a triangular notch. Also, list the advantages of a triangular notch over a rectangular notch.	*CO2*	*PO1*	**10**
		b)	A venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water in a horizontal pipe. If the pressure at inlet is 17.658 N/cm^2 and vacuum pressure at the throat is 30 cm of mercury, calculate the discharge of water through venturimeter. Take coefficient of discharge of the venturimeter as 0.98.	*CO2*	*PO1*	**10**
			UNIT - V			
	9	a)	A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. the pressure intensities in the large and smaller pipe are given as 13.73 N/cm^2 and 11.77 N/cm^2 respectively. i) Determine the loss of head due to contraction if the coefficient of contraction $C_c = 0.62$. ii) Determine the rate of flow of water through the pipe.	*CO3*	*PO1*	**10**
		b)	With appropriate example, explain the Hardy-Cross method of analyzing flow through pipes.	*CO3*	*PO1*	**10**
			OR			

	10	a)	With neat sketch, explain the following (i) Pipes in series (ii) Pipes in parallel (iii) Equivalent pipe (iv) Water hammer in pipes	*CO3*	*PO1*	**10**
		b)	Thee pipes of length 300 m, 170 m and 210 m and of diameters are 300 mm, 200 mm and 400 mm respectively are connected in series between two tanks. Coefficients of friction for these three pipes are 0.005, 0.0052 and 0.0048, respectively. The difference in water surface levels in two tanks is 12 m. Determine the rate of flow of water (i) considering all possible minor losses and (ii) neglecting minor losses.	*CO3*	*PO2*	**10**

****