U.S.N.										

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

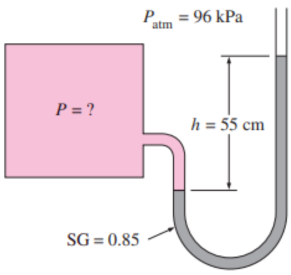
Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

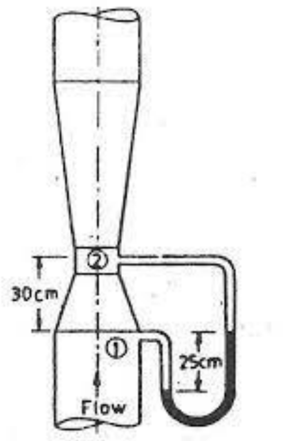
Programme: B.E. **Semester: III**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 23CH3PCFME / 22CH3PCFME **Max Marks: 100**
Course: Fluid Mechanics

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)	What are Newtonian and Non-Newtonian fluids? Explain in brief with a shear strain versus shear stress diagram.	*CO1*	*PO1*	**08**
	b)	A manometer is used to measure the pressure in a tank. The fluid used has a specific gravity of 0.85, and the manometer column height is 55 cm, as shown in Fig. If the local atmospheric pressure is 96 kPa, determine the absolute pressure within the tank. 	*CO2*	*PO3*	**04**
	c)	State the Hydrostatic law. With a neat diagram, derive the relation of hydrostatic equilibrium for incompressible and compressible fluids under isothermal conditions.	*CO1*	*PO1*	**08**
		OR			
2	a)	Derive the expression for inverted U-tube manometer with a neat sketch.	*CO2*	*PO3*	**10**
	b)	A flat plate of area 1.5 x 10^6 mm^2 is pulled with the speed of 0.4 m/s relative to another plate located at a distance 0.15 mm apart from it. Find the force and power required to maintain the speed, if the fluid separating them is having a viscosity of 1 Poise (1 Poise = 1/10 Pascal or 1/10 Ns/m^2 or 1 Ns/m^2 = 10 Poise. (Hint: Power = F*u)	*CO2*	*PO3*	**05**

		c)	If the atmospheric pressure at sea level is 101,430 N/m^2, determine the pressure at a height of 2500 m, assuming that the pressure variation follows: i. Hydrostatic law ii. Isothermal law. The density of air is given as 1.208 kg/m^3.	*CO3*	*PO3*	**05**
			UNIT – II			
	3	a)	Explain the three different correction factors for modified Bernoulli's equation with their defining expressions.	*CO4*	*PO2*	**10**
		b)	$0.7x10^{-3}$ m^3/s of acid slurry is to be pumped through a 50 mm diameter pipe, 30 m long, to a tank that is 12 m higher than its reservoir. The frictional losses amounts to 3 m and efficiency of the pump is 50%. Calculate (1) Power required to pump the acid and (2) Pressure developed by the pump. Data : Density of the acid slurry ρ_{Acid}= 1840 kg/m^3 and Viscosity of Acid μ_{Acid}=0.025 Ns/m^2	*CO4*	*PO2*	**10**
			OR			
	4	a)	Derive the Euler's equation of motion stating all assumptions and integrating to Bernoulli's equation.	*CO3*	*PO3*	**10**
		b)	Assume frictionless flow in a long, horizontal, conical pipe. The diameter is 2.0 ft (0.6096 m) at one end and 4.0 ft (1.2192 m) at the other. The pressure head at the smaller end is 16 ft of water ($47.825x10^3$ N/m^2). If water flows through this cone at a rate of 125.6 ft^3/sec (3.556 m^3/sec). Find the pressure head at the larger end.	*CO4*	*PO2*	**10**
			UNIT – III			
	5	a)	Define stagnation. Derive the expressions for stagnation temperature and pressure of a compressible fluid.	*CO4*	*PO2*	**10**
		b)	Derive the velocity of sound wave in a compressible fluid.	*CO2*	*PO3*	**10**
			OR			
	6	a)	Explain the area velocity relationship and effect of variation of area for subsonic, sonic and supersonic flows	*CO1*	*PO1*	**10**
		b)	A 30 cm x 15 cm venturi meter is provided in a vertical pipeline carrying oil of specific gravity 0.9. The flow being upwards, the difference in the elevation of throat section and entrance section of venturi meter is 30 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm. Take the coefficient of the meter as 0.98. Calculate: i. The discharge of oil ii. The pressure between entrance and throat section	*CO3*	*PO3*	**10**



			UNIT - IV			
	7	a)	Explain the standard procedures adopted to determine the performance curves of a typical centrifugal pump.	*CO4*	*PO2*	**10**
		b)	Find out the head and power developed to deliver a discharge of 60 lps by a three-stage centrifugal pump having impeller diameter, width and speed as 350 mm, 25 mm and 750 r.p.m respectively. The vanes having an angle 450 and occupy 10% of circumferential area. Assume the manometric efficiency and the overall efficiency as 90% and 80% respectively.	*CO4*	*PO2*	**10**
			OR			
	8	a)	Determine the power required to drive a centrifugal pump to deliver 0.035 m^3/s of water against a head of 25 m through a 16 cm diameter pipe and 150 m long. The overall efficiency of the pump is 75%. Use the formula $h_f = \frac{4fLV^2}{2gd}$ to determine the frictional losses in the pipe having co-efficient of friction 'f' as 0.15.	*CO4*	*PO2*	**10**
		b)	Derive the inlet and outlet velocity triangles for centrifugal pump work done by the impeller on the liquid.	*CO2*	*PO3*	**10**
			UNIT - V			
	9	a)	The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5 N^2 \rho\ \emptyset(\frac{\mu}{D^2 N \rho})$. Prove this by the Buckingham π-method of dimensional analysis.	*CO5*	*PO9*	**12**
		b)	Briefly explain any two of the following i. Geometric similarity ii. Kinematic similarity iii. Dynamic similarity	*CO5*	*PO9*	**08**
			OR			

	10	a)	What are the different dimensionless parameters used in fluid mechanics? Explain in detail.	*CO1*	*PO1*	**12**
		b)	The resisting force *R*, of a supersonic plane during flight, can be considered as dependent upon the length of the aircraft *l*, velocity *V*, air viscosity μ, air density ρ, and bulk modulus of air *k*. Express the functional relationship between the variables and the resisting force.	*CO6*	*PO2*	**08**

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