U.S.N.										

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

Autonomous Institute Affiliated to VTU

August 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 22CH4PCMT1 **Max Marks: 100**
Course: Mass Transfer-I

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of steam table and humidity chart is allowed.

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)	Derive general relation $N_A = u_m C_A + J_A$ for liquid phase diffusion in a binary system. Using the general relation, derive an equation for flux for uni-component diffusion in liquids, where $u_m = (N_A + N_B)/C$.	*CO 2*	*PO 2*	**12**
	b)	An open tank of 2 m diameter containing a liquid (of molecular weight = 78 kg/kmol) at 25°C is exposed to atmosphere in such a manner that liquid is covered with stagnant air film of 0.5 mm thick. Vapour pressure of liquid at 25°C is 100 mm Hg. Liquid cost is Rs 10/kg. The diffusivity of liquid vapour into air is 2×10^{-5} m^2/s. What is the value of loss of liquid from tank in one day?	*CO 3*	*PO 2*	**08**
		OR			
2	a)	Derive an equation to show relationship between overall and individual gas and liquid phase mass transfer co-efficients.	*CO 2*	*PO 2*	**10**
	b)	With neat sketches, illustrate Higbie's principle for mass transfer in turbulent flow.	*CO 1*	*PO 1*	**06**
	c)	Hydrogen gas at 2 standard atmosphere and 298 K diffuses through a rubber slab [2×2 m^2] of thickness 15 mm. The solubility of H_2 is 53×10^{-3} m^2 gas (STP)/m^2 solid/atm. $D_A = 1.82\times10^{-2}$ m^2/s. Determine rate of diffusion and express as gram of H_2 diffusing/h.	*CO 3*	*PO 2*	**04**
		UNIT - II			
3	a)	Describe the working of five cooling towers with sketches.	*CO 1*	*PO 1*	**10**
	b)	Explain the following. i. Adiabatic saturation temperature ii. Humid heat and humid volume	*CO 1*	*PO 1*	**10**

			OR			
	4	a)	Explain four methods of increasing humidity. Represent the operation on humidity chart.	*CO 1*	*PO 1*	**08**
		b)	A sample of air is at 1.013 bar and 35°C with a % saturation of 60%. It is required to alter the condition to i) temperature 25°C and humidity of 70% ii) Temperature 50 º C and % humidity 30%. Recommend operations to achieve above stated conditions and calculate the dew point.	*CO 4*	*PO 2*	**12**
			UNIT - III			
	5	a)	Derive an expression to calculate total drying time considering constant drying rate period and falling rate period.	*CO 2*	*PO 2*	**10**
		b)	Slabs of paper pulp 2 m × 2 m × 0.018 m is to be dried under constant drying conditions from 66.7% to 30% moisture. The value of equilibrium moisture for material is 0.5%. If the critical moisture content is 60% and the rate of drying at critical point is 1.5 kg/h/m^2. Calculate the drying time. The drying weight of each slab is 2.5 kg. Assume (i) all moisture contents are on wet basis (ii) drying takes place from two big faces.	*CO 3*	*PO 2*	**10**
			UNIT - IV			
	6	a)	Explain physical and chemical adsorptions in detail.	*CO 1*	*PO 1*	**08**
		b)	Mention the applications of four industrial adsorbents	*CO 1*	*PO 1*	**04**
		c)	Explain the principle and operation of fixed bed adsorber with a neat sketch.	*CO 5*	*PO 5*	**08**
			UNIT - V			
	7	a)	Explain the following: i. Mier's supersaturation theory and its limitations ii. Caking in crystallization and its prevention	*CO 1*	*PO 1*	**10**
		b)	A salt solution on 10,000 kg with 30 wt.% of Na_2CO_3 is cooled to 293 K. The salt crystallizes as dehydrate. What will be the yield of $Na_2CO_3.10H_20$ if solubility is 21.5 kg anhydrous/100 kg total water? Assume no water is lost due to evaporation.	*CO 3*	*PO 2*	**10**

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