Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

UG / PG DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2026

Fourth Semester

Chemical Engineering

CH3451 / UCHT24401 - MASS TRANSFER I

(Psychrometric Chart Can be Permitted)

Regulations – 2021/2024

Duration : 3 Hrs ***Maximum : 100 Marks***

PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	What are some common industrial processes that rely on mass transfer operations?	L1	1	2
2.	What factors should be considered when predicting the diffusivity of a substance?	L1	1	2
3.	What are mass transfer coefficients and why are they important in mass transfer operations?	L2	2	2
4.	What is the difference between individual and overall mass transfer coefficients?	L2	2	2
5.	How is the wet bulb temperature related to dry bulb temperature and relative humidity?	L2	3	2
6.	Write the concept of enthalpy transfer apply to both heating and cooling processes in dehumidifiers and humidifiers?	L1	3	2
7.	How does moisture content change during the drying process?	L2	4	2
8.	How does the airflow affect the drying process in cross-through circulation drying?	L2	4	2
9.	What is equilibrium in crystallization?	L1	5	2
10.	What is the relationship between supersaturation and nucleation rate?	L1	5	2

PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)

Q.No			*Questions*	*BLT*	*CO*	*Marks*
11.	a	i	Elaborate the molecular diffusion in gases, liquids, and solids.	L2	1	8
		ii	Discuss the methods used to measure diffusivity in gases, liquids, and solids.	L2	1	8
			Or			
	b	i	Explain the concept of multi-component diffusion.	L2	1	10
		ii	Write in detail about the challenges in predicting and studying multi-component diffusion?	L2	1	6
12.	a	i	A gas is absorbed into a liquid in a packed column. The Sherwood number is found to be Sh=2.5, and the Reynolds number for the system is Re=1500. The Schmidt number for the system is Sc=1000. The diameter of the packing is 0.05 m, and the diffusivity of the gas in the liquid is $D=2\times10^{-9}$ m^2/s. Calculate the mass transfer coefficient kL.	L3	2	10
		ii	Discuss the factors that influence Eddy Diffusion and its importance in processes such as heat and mass transfer.	L3	2	6
			Or			
	b	i	In a distillation column, the operating conditions are such that the molar flow rate of the liquid is 0.5 kmol/s, and the molar flow rate of the vapor is 0.7 kmol/s. The relative volatility of the component being separated is 2.5. The column operates at a reflux ratio of 2. If the number of theoretical plates required for a 95% separation is 10, calculate the number of transfer units (NTU) for this distillation process.	L3	2	10
		ii	Discuss the differences between stage-wise and differential contactors in mass transfer operations.	L3	2	6
13.	a	i	In a vessel at 1 bar and 300 K, the % RH of water vapor in the air is 25. If the partial pressure of water vapor when the air is saturated with vapor at 300 K is 3.6 kN/m^2. Calculate:	L3	3	10

			a) The partial pressure of water b) The absolute humidity of air c) The percentage humidity d) The humid volume.			
		ii	The percentage humidity of air at 30°C and a total pressure of 750 mmHg is 20%. Calculate the RH and partial pressure of water vapor in the air. What is the dew point of the air?	L3	3	6
			Or			
	b	i	Explain the role of energy efficiency in the design of humidification systems and cooling towers.	L3	3	10
		ii	Discuss the industrial applications of humidification systems and cooling towers.	L3	3	6
14.	a		A 100 kg batch of granular solids containing 30% moisture is to be dried in a tray drier to 16% moisture by passing a current of air at 350 K tangentially across its surface at a velocity of 2 m/s. If the constant rate of drying under these conditions is $0.7x10^{-3}$ kg/m^2s and the critical moisture content is 15%, calculate the time required for drying. (Consider drying surface 0.03 m^2/kg dry weight).	L3	4	16
			Or			
	b	i	Discuss the material and energy balance in continuous dryers.	L3	4	8
		ii	Explain the advance drying techniques such as freeze drying and microwave drying.	L3	4	8
15.	a		An aqueous solution of sodium sulfate containing 28% Na_2S0_4 is cooled to 20°C and left undisturbed so that $Na_2S0_410H_2O$ crystals are formed. Calculate how much crystals will be deposited from a 500 kg original solution. What will be the yield of crystallization? Assume the solubility of $Na_2S0_410H_2O$ at 20°C is 19.4 kg/100 kg H_2O.	L3	5	16
			Or			
	b	i	Explain the primary design considerations when designing a batch crystallizer.	L3	5	8
		ii	Discuss the design and operation of a continuous crystallizer.	L3	5	8

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