Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E / B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2025

Fourth Semester

Chemical Engineering

CH3451 – Mass Transfer-I

Psychrometric Chart Can be Permitted

Regulations – 2021

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

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

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	State Fick's law of diffusion.	L1	1	2
2.	Distinguish between molecular diffusion and eddy diffusion.	L2	1	2
3.	Compare HTU and NTU.	L2	2	2
4.	Define the term overall mass transfer coefficient.	L1	2	2
5.	Define Dew point.	L1	3	2
6.	Compare - Wet bulb temperature with Dry bulb temperature.	L2	3	2
7.	Indicate the various regimes of drying.	L1	4	2
8.	Distinguish between bound and unbound moisture.	L2	4	2
9.	State ΔL of crystal growth.	L1	5	2
10.	How would you classify the type of crystal nucleation?	L2	5	2

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

Q.No			*Questions*	*BLT*	*CO*	*Marks*
11.	a	i	In oxygen- nitrogen gas mixture at 1 atm, 25ºC, the concentrations of oxygen at two planes 0.2 cm apart are 10 and 20-volume % respectively. Estimate the rate of diffusion of oxygen expressed as gm mole /(sq cm) (sec) for the case where a) The nitrogen is non- diffusion b) There is equimolar counter diffusion of the two gases. Diffusivity of oxygen in nitrogen at 25ºC and 1 atmosphere is 0.206 cm^2/sec.	L3	1	8
		ii	Explain the experimental method of determination of diffusivity.	L3	1	8
			Or			
	b	i	Develop an expression for the steady state diffusion of gas A through a stagnant film of non diffusing gas B.	L3	1	10
		ii	Ammonia is diffusing through an inert air film 2 mm thick at a temperature of 20ºC and a pressure of 1 atm. The concentration of ammonia is 10% by volume on one side of the film and zero on the other side. Determine the mass flux. Estimate the effect on the rate	L3	1	6

			of diffusion if the pressure is increased to 10 atmospheres. The diffusivity of NH_3 in air at 20ºC and 1 atm. is 0.185 cm^2/s.			
12.	a		Discuss about the various theories to explain the turbulent mass transfer.	L2	2	16
			Or			
	b	i	Explain the concept of analogy and develop the Reynolds analogy from fundamentals.	L2	2	10
		ii	Explain how mass transfer coefficients are estimated under laminar flow conditions.	L2	2	6
13.	a	i	Air is entering into a cooling tower with characteristics as follows: Dry bulb temperature = 25ºC, Wet bulb temperature = 22ºC and Pressure = 1 atm. Calculate (i) humidity, (ii) % humidity, (iii) % relative humidity and (iv) Dew point.	L5	3	8
		ii	A mixture of nitrogen- acetone vapour at 800 mm Hg and 25ºC has percentage saturation of 80%. Calculate (i) absolute humidity (ii) partial pressure of acetone (iii) absolute molal humidity and (iv) volume percent of acetone. Assume vapour pressure of acetone at 25ºC is 190 mm Hg.	L5	3	8
			Or			
	b		With a neat sketch, explain the working principle of spray chamber and indicate different process involved using a humidity chart.	L5	3	16
14.	a	i	Explain the mechanism of dying during constant rate and falling rate period.	L2	4	10
		ii	Briefly explain the factors affecting the rate of drying.	L2	4	6
			Or			
	b		Explain the principle and applications of rotary dryer and represent their different modes of operation with neat diagram.	L2	4	16
15.	a		A Swenson – Walker crystallizer is to produce 800 kg per hour of FeSO4.7H2O crystals. The saturated solution enters the crystallizer at 49°C and the slurry leaves at 27°C. Cooling water enters the crystallizer jacket at 15°C and leaves at 21°C. The overall heat transfer coefficient has been estimated to be 175 kcal/(hr)(m^2)(°C). There are 1.3 m^2 of cooling surface per meter of crystallizer length. (i) Estimate the cooling water requirement in kg/hr. (ii)Determine the number of crystallizer sections, each section being 3 meter long. Data: Saturated solutions of FeSO4 at 49°C and 27°C contain 140 parts and 74 parts of FeSO4.7H2O per 100 parts of excess water respectively. Average specific heat of the initial solution is 0.70 and the heat of crystallization is 15.8 kcal/kg.	L5	5	16

Or

b	i	Discuss how crystal growth is controlled in a continuous crystallizer.	L5	5	10
	i i	A solution of sodium carbonate in water is saturated at a temperature of 10℃.Calculate the weight of Na2CO3 10H2O needed to dissolve in 200 kg of original solution at 30℃. Data: Solubility at 30℃ = 38.8 gm of Na2CO3/100gm of water Solubility at 10℃ = 12.5 gm of Na2CO3/100gm of water	L5	5	6