QP Code: RA23BTECH119 Reg. No | | | | | | | | | | | AY 23

GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, ODISHA, GUNUPUR
(GIET UNIVERSITY)

B. Tech (Fourth Semester - Regular) Examinations, April – 2025

23BCHPC24002 – Mass Transfer-I

(Chemical Engineering)

Time: 3 hrs Maximum: 60 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

	Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a.	Why is diffusion slower in liquids than in gases?	CO1	K2
b.	How does the surface renewal theory differ from two-film theory?	CO2	K2
c.	What are the advantages of using counter-current flow in gas absorption?	CO3	K1
d.	What is the difference between enriching and stripping sections?	CO4	K1
e.	What is the significance of the psychrometric chart?	CO6	K2

PART – B **(10 x 5 = 50 Marks)**

	Answer ***ALL*** the questions	Marks	CO #	Blooms Level
2. a.	Calculate the amount of diffusion of acetic acid in 2 hours across a film on non-diffusing water solution 1mm thick at 17^0C when the concentrations of opposite side of the film are 9 wt% and 3 wt%, respectively. The diffusivity of acetic acid in solution is $0.95*10^{-9}$ m^2/s. Data at 17^0C is as follows: Density of 9wt% solution=1012kg/m^3 Density of 3wt% solution=1003.2kg/m^3 Molecular weight of acetic acid=60.03 Molecular weight of water=18.02	10	CO1	K3
	(OR)			
b.	In a nitrogen-oxygen gas mixture at 1 atm & 25^0C, the concentration of oxygen at two planes 3mm apart are 20 and 10 volume %, respectively. Calculate the rate of diffusion of oxygen expressed as kmol oxygen/m2.sec for the case where there is equi-molar counter diffusion of the two gases. The diffusivity for the system is 0.206 cm^2/s.	10	CO1	K3
3.a.	Explain analogy between heat, mass and momentum briefly.	5	CO2	K2
b.	Explain the controlling film concept.	5	CO2	K2
	(OR)			
c.	Differentiate between extractive and azeotropic distillation.	5	CO4	K2
d.	Write the selection criteria for absorbent.	5	CO3	K2
4.a.	A gas mixture containing 31wt% ammonia and 69wt% air is absorbed in water in a counter-current packed tower. The gas and liquid flow rate on solute free basis are 2150mol/hr m^2 and 5376mol/hrm^2, respectively. The inlet water is pure and the exit gas contains 1.5% of ammonia entering the tower. The equilibrium relation is: Y = 1.6X, where Y = kg ammonia/kg air and X=kg ammonia/kg water. Determine the height of the tower, if the height of transfer unit is 2.4m.	10	CO3	K3
	(OR)			

b.	An air-ammonia mixture containing 5% ammonia by volume is Absorbed in water in a packed column operated at 293Kand 101.325kPapressure so as to recover 98% ammonia by volume. If the inert gas mass velocity to column is 1200kg/m^2hr, calculate the mass velocity of water to this column if the column is operated at 1.25 times the minimum liquid rate to column. Also calculate the composition of liquid leaving column corresponding to this condition. Equilibrium relationship is: y=1.154x Where x & y are mole fractions.	10	CO3	K3
5.a.	A mixture of 35mol% A and 65mol% B is to be separated in a fractionating column. The concentration of A in distillate is 93mol% and 96% of all product A is in distillate. The feed is half vapour. The reflux ratio is to be 4. The relative volatility of A to B is 2. Calculate the number of theoretical stages in the column and locate the feed plate.	10	CO4	K3
	(OR)			
b.	A methanol-water solution contains 50wt% methanol. It is to be continuously rectified in a column operating at atmospheric pressure to obtain a distillate containing 95% methanol and a residue containing 5% methanol by wt. the feed enters the column at its bubble point. It is proposed to operate the column at a reflux ratio of 1.5. Find the number of theoretical plates required to effect a given separation and the position of feed plate.	10	CO4	K3

x	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y	0	0.42	0.57	0.66	0.73	0.78	0.83	0.87	0.93	0.96	1.0

6.a.	The DBT and WBT on a particular day are observed as 345K and 287K. Using Psychrometric chart, find absolute humidity, % relative humidity, dew point and enthalpy.	10	CO5	K2
	(OR)			
b.	Explain the working principle, advantages and disadvantages of hair hygrometer with neat sketch.	6	CO6	K2
c.	Differentiate between relative and absolute humidity.	4	CO5	K2

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