GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Fourth Semester Regular) Examinations, May – 2024

22BCHPC24002 – Mass Transfer - I

(Chemical)

Time: 3 hrs | Maximum: 70 Marks

(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. Give some essential characteristic of a good absorbent.	CO2	K1
b. Differentiate molecular diffusion and eddy diffusion.	CO1	K3
c. When is steam distillation recommended?	CO3	K2
d. Write the relation between absolute humidity and molar humidity.	CO4	K1
e. Define Fick's law of diffusion.	CO1	K2

PART – B **(15 x 4 = 60 Marks)**

Answer ***ALL*** questions	Marks	CO #	Blooms Level
2. a. Methane diffuses at steady state through the tube containing helium. At point 1, the partial pressure of methane is 55kPa and at point 2, it is 15kPa. Both the points are 30mm apart. The total pressure is 101.3kPa and temperature is 298K. Calculate the flux of methane at steady state i. For equimolar counter diffusion. Take the value of diffusivity as 6.75*10-5m^2/s. ii. For helium as non-diffusing component.	10	CO1	K3
b. Explain details about film theory.	5	CO1	K2
(OR)			
c. Hydrochloric acid at 283K diffuses through a thin film of water 4mm thick. The concentration of A at location 1 on one boundary of the film is 12% weight (density = 1060.7kg/m^3) and on the other boundary at location 2 is 4% weight (density = 1020.15kg/m^3). The diffusivity of HCl in water is assumed as 2.5*$10^{-9}$$m^2$/s. Calculate the flux of diffusion of A assuming water to be stagnant.	10	CO1	K3
d. Explain details about surface renewal theory.	5	CO1	K2
3.a. Benzene is to be recovered from coal gas by scrubbing it with wash oil as an absorbent. Absorber handles 900m^3/hr of coal containing 2% by volume benzene. Coal gas enters at a temperature at 300K and 107.324kPa pressure. 95% of the benzene should be recovered by the solvent. The solvent enters at 300K containing 0.005 mole fraction of benzene and has an average molecular weight of 260. Calculate the circulation rate of oil per hour if the column is to be operated at 1.5 times the minimum oil circulation rate. Equilibrium data is: $\frac{Y}{1+Y} = 0.125\frac{X}{1+X}$ Where Y = mole ratio of benzene to dry coal gas, X = mole ratio of benzene to	10	CO2	K3

benzene free solvent.

b.	Explain spray column in details with neat sketch.	5	CO2	K2
	(OR)			
c.	An ammonia-air mixture containing 2% by volume of ammonia is to be scrubbed with water at 20^0C in an absorption tower. The water and gas rates are 1170kg/hr.m^2 each, based on empty tower cross section. Estimate the height of the tower required if 98% of ammonia in the entering gas is to be absorbed. The tower operates at 1 atm pressure, the equilibrium relation is: $y_e = 0.746x$ Where y_e = mole fraction of ammonia in air x = mole fraction of ammonia in solution with water. Overall mass transfer co-efficient is assumed as 128 kgmole.Hr.m^3.atm.	10	CO2	K3
d.	Discuss in details about the materials used for packing.	5	CO2	K2
4.a.	A mixture of 35 mole% A and 65 mole% B is to be separated in a fractionation column. The concentration of A in the distillate is 93mol% and 96% of all product A is in distillate. The feed is half vapour and the reflux ratio is to be 4. The relative volatility of A to B is 2. Calculate the number of theoretical plates in the column and locate the feed plate.	15	CO3	K3
	(OR)			
b.	A feed containing 50 mole% benzene & 50 mole% toluene is to be distilled in a fractionating column to produce a distillate containing 90 mole% benzene and bottoms containing 90 mole% toluene. Feed rate to the column is 10,000 kg/day and feed is at its bubble point. The operating reflux ratio is 1.5 times the minimum reflux ratio. Determine the theoretical plates required. Assume the value of relative volatility as 2.28.	15	CO3	K3
5.a.	A mixture of acetone vapor and nitrogen contains 14.8% acetone by volume. Calculate the following at 293K and pressure 99.33kPa. i. Partial pressure of acetone ii. Moles of acetone/mole of nitrogen iii. Relative humidity at 293K iv. %saturation at 293K	10	CO4	K3
b.	Distinguish between azeotropic and extractive distillation.	5	CO3	K4
	(OR)			
c.	The DBT and WBT on a particular day are observed as 308K and 299K. Using Psychrometric chart, find absolute humidity, % relative humidity, dew point and enthalpy.	8	CO4	K3
d.	Explain details about Hair hygrometer with neat sketch.	7	CO4	K3

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