Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

B. Tech (Fourth Semester – Regular/Supplementary) Examinations, April 2026

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. Define Fick's law of diffusion.	CO1	K1
b. Define Schimdt number.	CO2	K1
c. Differentiate between random and structured packing arrangement.	CO3	K1
d. Write the basic assumption of surface renewal theory.	CO4	K1
e. What is dew point temperature?	CO5	K1

PART – B **(10 x 5 = 50 Marks)**

Answer ***ALL*** the questions		Marks	CO #	Blooms Level
2. a.	A methane–air gaseous mixture is maintained at a total pressure of 6 atm and a temperature of 40°C. Methane diffuses through stagnant air, and its concentration changes from 20% to 8% by volume over a distance of 0.3 cm. The diffusivity of methane in air is 0.22 cm^2/s under these conditions. Determine the rate of diffusion of methane in $g/cm^2 \cdot hr$	10	CO1	K3
	(OR)			
b.	Ethanol diffuses through a stagnant layer of water of thickness 3 mm at a temperature of 300 K. The concentration of ethanol at one boundary of the film is 15 wt% (density = 980 kg/m^3), while at the other boundary it is 5 wt% (density = 960 kg/m^3). The diffusivity of ethanol in water under these conditions is 1.8×10^{-9} m^2/s. Determine the diffusion flux of ethanol through the liquid film.	10	CO1	K3
3.a.	A binary mixture having 45 mol% light components is separated by distillation to produce a distillate containing 95 mol% light components and a residue containing 5 mol%. The feed enters the column in a condition such that it contains 20% vapor and 80% liquid. The average relative volatility is 2.5. Calculate the number of theoretical plates required and determine the position of the feed plate.	10	CO4	K3
	(OR)			
b.	A feed containing 45 mole% benzene & 55 mole% toluene is to be distilled in a fractionating column to produce a distillate containing 96 mole% benzene and bottoms containing 98 mole% toluene. Feed rate to the column is 18,000 kg/day and feed is at its bubble point. The operating reflux ratio is 2.1 times the minimum reflux ratio. Determine the theoretical plates required and the feed plate location. Assume the value of relative volatility as 2.16.	10	CO4	K3
4.a.	A gas stream containing 3% ammonia is absorbed in water at 27°C using a packed tower with 1.5 cm Raschig rings. Gas and liquid rates are 1200 $kg/hr.m^2$. If 97% ammonia removal is required, calculate the tower height.	10	CO3	K3

	The HTU is 2.4 m. The equilibrium relation is given as: y=0.8x.			
	(OR)			
b.	An ammonia–air mixture with 3.5% NH_3 is scrubbed at 25°C using water in a packed column. The water and gas flow rates are 1560 kg/hr.m² each. If 98% removal is required, determine the height of packing. The height of the transfer unit is given 2.4 m. The equilibrium relation is: y=1.48x.	10	CO3	K3
5.a.	Explain briefly analogy between heat, mass and momentum transfer.	5	CO2	K1
b.	Define mass transfer coefficient and explain its physical significance with units.	5	CO2	K2
	(OR)			
c.	Explain in details about surface renewal theory.	5	CO2	K2
d.	Explain the controlling film concept.	5	CO2	K1
6.a.	Describe the psychrometric chart and its components.	5	CO5	K2
b.	Explain how humidity, temperature, and enthalpy are represented on a psychrometric chart.	5	CO6	K2
	(OR)			
c.	The dry bulb temperature (DBT) and wet bulb temperature (WBT) of air are 330 K and 300 K, respectively. Using a psychrometric chart, determine Absolute humidity, Relative humidity and Dew point temperature.	5	CO5	K2
d.	A gas mixture containing benzene vapour is saturated at 101.325 kPa and 323 K. Calculate the absolute humidity if the other component of the mixture nitrogen and carbon dioxide. Vapour pressure of benzene at 323 K is 36.664 kPa.	5	CO6	K2

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