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**Enrolment No:** 



## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

**End Semester Examination, May 2023** 

Programme Name: B.Tech (APE Gas)

Course Name : Mass Transfer

Course Code : CHCE 2022

Semester : IV

Duration : 3 h

Max. Marks: 100

Nos. of page(s): 02

**Instructions:** In case of data missing make necessary assumptions

S.No	Section A (Attempt all questions)  Marks						
	Section A (Attempt an questions)	Marks	CO				
Q 1	State Fick's law and compare (i) Molecular diffusion and Eddy diffusion (ii) N-type		CO1				
	flux and J-type flux.	12 M					
Q 2	With the help of a typical drying curve, explain the following:						
	i) Constant and falling rate periods						
	ii) Equilibrium moisture content						
	iii) Bound moisture						
	iv) Free moisture content						
Q 3	What are the desired characteristics of solvent used for Liquid-Liquid extraction?						
	Also, explain the effect of temperature and pressure on Liquid-Liquid equilibria?	12 M	CO3				
Q 4	Derive the operating line equation for steady state continuous counter current mass	10.14	GOA				
	transfer.	12 M	CO2				
Q 5	With neat schematic diagram, describe different types of packing materials used to						
	carry out absorption operation. Also, explain their characteristics.	12 M	CO3				
	Section B (Attempt all questions)						

Q 7 500 kg of an aqueous solution containing 50% acetone is contacted with 800 kg of chlorobenzene containing 0.5 mass% acetone in a mixer -settler unit, followed by separation of the extract and the raffinate phases. Determine the composition of the extract and the raffinate phases and the fraction of acetone extracted.  Equilibrium Data:    Aqueous Phase (Raffinate)   Organic Phase (Extract)   Water   Chlorobenzene   Acetone   Acetone   Acetone	Q 6	A continuous fractionating column is to be designed for separating 10,000 kg per												
water into an overhead product containing 97 mole percent methanol and a bottom product having 98 mole percent water. A mole reflux ratio of 3 is used. Calculate (i) moles of overhead product obtained per hour and (ii) number of ideal plates and location of the feed plate if the feed is at its bubble point.    x	_	hour of a liquid mixture containing 40 mole percent methanol and 60 mole percent												
product having 98 mole percent water. A mole reflux ratio of 3 is used. Calculate (i) moles of overhead product obtained per hour and (ii) number of ideal plates and location of the feed plate if the feed is at its bubble point.    x														
(i) moles of overhead product obtained per hour and (ii) number of ideal plates and location of the feed plate if the feed is at its bubble point.    x		water into an overhead product containing 97 mole percent methanol and a bottom												
CO		product having 98 mole percent water. A mole reflux ratio of 3 is used. Calculate								ulate				
CO   Co   Co   Co   Co   Co   Co   Co									s and					
X										20 M	CO4			
y   0.417   0.579   0.669   0.729   0.78   0.825   0.871   0.915   0.959														
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Co   Co   Co   Co   Co   Co   Co   Co														
Chlorobenzene containing 0.5 mass% acetone in a mixer -settler unit, followed by separation of the extract and the raffinate phases. Determine the composition of the extract and the raffinate phases and the fraction of acetone extracted.    Equilibrium Data:   Organic Phase (Extract)		y	0.417	0.579 0.6	569	0.729	0.78	0.825	0.871	0.915	0.959			
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Separation of the extract and the raffinate phases. Determine the composition of the extract and the raffinate phases and the fraction of acetone extracted.    Equilibrium Data:   Organic Phase (Extract)	~ /									•				
Equilibrium Data:    Aqueous Phase (Raffinate)		chlorobenzene containing 0.5 mass% acetone in a mixer -settler unit, followed by									ed by			
Equilibrium Data:     Organic Phase (Extract)   Water   Chlorobenzene   Acetone   XA   XB   XC   YA   YB   YC   O.9989   O.0011   O   0.0018   O.9982   O   0.8979   O.0021   O.1   0.0049   0.8872   O.1079   O.7969   O.0031   O.2   O.0079   O.7698   O.2223   O.6942   O.0058   O.3   O.0172   O.608   O.3748   O.5864   O.0136   O.4   O.0305   O.4751   O.4944   O.4628   O.0372   O.5   O.0724   O.3357   O.5919   O.2741   O.1259   O.6   O.2285   O.1508   O.6107   O.608   O.6107		sepa	separation of the extract and the raffinate phases. Determine the composition of the											
Equilibrium Data:    Aqueous Phase (Raffinate)														
Aqueous Phase (Raffinate)         Organic Phase (Extract)           Water         Chlorobenzene         Acetone           XA         XB         XC         YA         YB         YC           0.9989         0.0011         0         0.0018         0.9982         0           0.8979         0.0021         0.1         0.0049         0.8872         0.1079           0.7969         0.0031         0.2         0.0079         0.7698         0.2223           0.6942         0.0058         0.3         0.0172         0.608         0.3748           0.5864         0.0136         0.4         0.0305         0.4751         0.4944           0.4628         0.0372         0.5         0.0724         0.3357         0.5919           0.2741         0.1259         0.6         0.2285         0.1508         0.6107		CALIC	ict and th	e rammate p	masc	s and the	macm	on or ac	ctone ex	nacica.				
$\begin{array}{ c c c c c c c c c }\hline Water & Chlorobenzene & Acetone \\\hline x_A & x_B & x_C & y_A & y_B & y_C \\\hline 0.9989 & 0.0011 & 0 & 0.0018 & 0.9982 & 0 \\\hline 0.8979 & 0.0021 & 0.1 & 0.0049 & 0.8872 & 0.1079 \\\hline 0.7969 & 0.0031 & 0.2 & 0.0079 & 0.7698 & 0.2223 \\\hline 0.6942 & 0.0058 & 0.3 & 0.0172 & 0.608 & 0.3748 \\\hline 0.5864 & 0.0136 & 0.4 & 0.0305 & 0.4751 & 0.4944 \\\hline 0.4628 & 0.0372 & 0.5 & 0.0724 & 0.3357 & 0.5919 \\\hline 0.2741 & 0.1259 & 0.6 & 0.2285 & 0.1508 & 0.6107 \\\hline \end{array}$		Equi	librium D	Data:										
$\begin{array}{ c c c c c c c c c }\hline Water & Chlorobenzene & Acetone \\\hline x_A & x_B & x_C & y_A & y_B & y_C \\\hline 0.9989 & 0.0011 & 0 & 0.0018 & 0.9982 & 0 \\\hline 0.8979 & 0.0021 & 0.1 & 0.0049 & 0.8872 & 0.1079 \\\hline 0.7969 & 0.0031 & 0.2 & 0.0079 & 0.7698 & 0.2223 \\\hline 0.6942 & 0.0058 & 0.3 & 0.0172 & 0.608 & 0.3748 \\\hline 0.5864 & 0.0136 & 0.4 & 0.0305 & 0.4751 & 0.4944 \\\hline 0.4628 & 0.0372 & 0.5 & 0.0724 & 0.3357 & 0.5919 \\\hline 0.2741 & 0.1259 & 0.6 & 0.2285 & 0.1508 & 0.6107 \\\hline \end{array}$		Aqueous Phase (Raffinate) Organic Phase (Extract)								1				
XA         XB         XC         YA         YB         YC           0.9989         0.0011         0         0.0018         0.9982         0           0.8979         0.0021         0.1         0.0049         0.8872         0.1079           0.7969         0.0031         0.2         0.0079         0.7698         0.2223           0.6942         0.0058         0.3         0.0172         0.608         0.3748           0.5864         0.0136         0.4         0.0305         0.4751         0.4944           0.4628         0.0372         0.5         0.0724         0.3357         0.5919           0.2741         0.1259         0.6         0.2285         0.1508         0.6107		,					Wa				•			
0.8979         0.0021         0.1         0.0049         0.8872         0.1079           0.7969         0.0031         0.2         0.0079         0.7698         0.2223           0.6942         0.0058         0.3         0.0172         0.608         0.3748           0.5864         0.0136         0.4         0.0305         0.4751         0.4944           0.4628         0.0372         0.5         0.0724         0.3357         0.5919           0.2741         0.1259         0.6         0.2285         0.1508         0.6107											20 M	CO2		
0.7969         0.0031         0.2         0.0079         0.7698         0.2223           0.6942         0.0058         0.3         0.0172         0.608         0.3748           0.5864         0.0136         0.4         0.0305         0.4751         0.4944           0.4628         0.0372         0.5         0.0724         0.3357         0.5919           0.2741         0.1259         0.6         0.2285         0.1508         0.6107		(	0.9989 0.0011 0 0.0018 0.9982 0							Í				
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0.5864     0.0136     0.4     0.0305     0.4751     0.4944       0.4628     0.0372     0.5     0.0724     0.3357     0.5919       0.2741     0.1259     0.6     0.2285     0.1508     0.6107		(	).7969				0.0	079	0.769	8				
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			).2566	0.1376		0.6058	0.2	566	0.137	6	0.6058			