GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Fifth Semester Regular) Examinations, December – 2023

21BCHPC35004 – Mass Transfer-II

(Chemical)

Time: 3 hrs Maximum: 70 Marks

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

		CO #	Blooms Level
Q.1.	Answer ***ALL*** questions		
a.	What is the relationship between solvent requirement and no. of stages required for counter-current LLE?	CO2	K2
b.	Which extractor is used for radio-active solution separation?	CO1	K2
c.	What are the different equipment's used for fine solid separation from feed mixture and for oil extraction from oil seed?	CO2	K3
d.	Which adsorbent is used for decolorizing petroleum products?	CO3	K3
e.	What are the advantages of continuous drying over batch drying?	CO4	K2

PART – B **(15 x 4 = 60 Marks)**

		Marks	CO #	Blooms Level
Answer ***ALL*** questions				
2. a.	100 kg of acetic acid-water solution containing 25% of acetic acid by weight is to be extracted with Isopropyl ether at 200C. the total solvent used for extraction is 100 kg. determine the quantities and compositions of various streams if: (i) The extraction is carried out in single stage (ii) The extraction is carried out at two different stages with 50kg of solvent in each stage.	15	CO1	K3

Equilibrium data:

Water layer (wt. %)		*Ether layer* (wt. %)	
Acid (x)	*Water (A)*	*Acid (y)*	*Water (A)*
0.69	98.1	0.18	0.5
1.41	97.1	0.37	0.7
2.9	95.5	0.79	0.8
6.42	91.7	1.93	1.0
13.3	84.4	4.82	1.9
25.5	71.1	11.4	3.9
36.7	58.9	21.6	6.9
44.3	45.1	31.1	10.8
46.4	37.1	36.2	15.1

(OR)

b.	A 2.25 kg of pyridine-water solution containing 50% pyridine is to be counter-currently extracted with chlorobenzene to reduce the pyridine concentration to 2% in final raffinate. Determine the no. Of theoretical stages required if 2.3 kg of solvent is used? The equilibrium data is as below:	15	CO1	K3

Extract phase			Raffinate phase		
Pyridine	Chlorobenzene	Water	Pyridine	Chlorobenzene	Water
0	99.95	0.05	0	0.08	99.92
11.05	88.28	0.67	5.02	0.16	94.82
18.95	79.9	1.15	11.05	0.24	88.71
28.6	69.15	2.25	25.5	0.58	73.92
35.05	61	3.95	44.95	4.18	50.87
40.6	53	6.4	53.2	8.9	37.9
49	37.8	13.2	49	37.8	13.2

3.a. Oil is to be extracted from meal by means of benzene using counter current extractor. The unit is to treat 1000kg of meal per hour. The untreated meal contains 365kg of oil and 30 kg of benzene. The fresh solvent mixture contains 14kg of oil and 590kg of benzene. The exhausted solid is to contain 55 kg of unextracted oil. Find the number of stages required, if the solution retained depends on the concentration of solution as follows: 15 CO2 K3

Concentration (kg oil/ kg solution)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Solution retained (kg/kg solid)	0.5	0.505	0.515	0.53	0.55	0.571	0.595	0.62

(OR)

b. Crushed oil seeds containing 55 % oil by weight are to be extracted at the rate of 4000 kg/hr using 6000 kg/hr of hexane containing 5 % oil by weight as the solvent. A counter current 2-stage extraction system is used. The oil seeds retain 1 kg of solution per kg of oil free cake. Calculate the percent recovery of oil obtained under above conditions. 15 CO2 K3

4.a. An aqueous solution containing valuable solute is coloured by small amount of impurity. Decoloriztion experiments of an aqueous solution yielded the following equilibrium relation: 10 CO3 K3

$Y = 8.91*10^{-5}X^{1.66}$

Where X = color unit/ kg carbon and Y = color unit/ kg solution

1000 kg of initial solution with color concentration of 9.6 color unit/kg solution is to be treated with an adsorbent. Calculate the Percentage of original color removed in single stage using 32 kg of fresh adsorbent. Also calculate the quantity of fresh adsorbent to reduce the color to 10% of its original value in 2-stage counter current operation assuming that color concentration in the solution stream leaving first stage is 4.6 times the final color of the solution.

b. Describe in details about Swanson Walker Crystallizer. 5 CO3 K2

(OR)

c. Experiments on decolorisation of oil yielded the following equilibrium relationship: 10 CO3 K3

$Y = 0.5x^{0.5}$

Where y = gm of color removed/gm of adsorbent

x = color in oil, gm of color/1000 gm of color-free oil

100 kg of oil containing 1 part of color to 3 parts of oil is agitated with 25kg of the adsorbent. Calculate the % of color removed if: All 25kg adsorbent is used in one step. 12.5kg adsorbent is used initially, followed by another 12.5kg of adsorbent.

d.	Describe in details about Oslo evaporative Crystallizer.	5	CO3	K2
5.a.	Slabs of paper pulp 100*100*1.5cm^3 are to be dried under constant drying conditions from 67% to 30% moisture. The value of equilibrium moisture for the material is 0.5%. If critical moisture is 60% and rate of drying at critical point is 1.5kg/m^2 hr, calculate the drying time. The dry weight of each slab is 2.5kg. Drying is taking place in 2 big faces of the slab. All the moisture contents are on wet basis. The falling rate may be assumed to be linear.	10	CO4	K3
b.	Describe in details about tunnel dryer.	5	CO4	K2
	(OR)			
c.	A batch of solid is to be dried from 28% to 6% moisture on wet basis. The initial weight of the solid is 380kg and the drying surface is 0.15 m^2/40kg dry weight. The critical moisture content is 18% on dry basis and the constant drying rate is 0.32 kg/(m^2.hr). For the falling rate period, the following data are available.	10	CO4	K3

X, % dry basis	0.25	0.219	0.19	0.16	0.136	0.11	0.082	0.075	0.064
N	0.3	0.27	0.24	0.21	0.18	0.15	0.07	0.044	0.025

d.	Describe in details about drum dryer.	5	CO4	2

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