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GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Fifth Semester – Regular) Examinations, December – 2022

BPCCH5040 – Mass Transfer – II

(Chemical Engineering)

Time: 3 hrs

Maximum: 70 Marks

Answer ALL Questions

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions)

(1 x 10 = 10 Marks)

Q.1. Answer ALL questions

[CO#] [PO#]

- a. The apex of an equilateral-triangular coordinate (in ternary liquid system) represents a/an _____ [CO1] [PO1]
 (i) pure component (ii) binary mixture
 (iii) ternary mixture (iv) insoluble binary system
- b. In extraction, as the temperature increases, the area of heterogeneity (area covered by binodal curve) _____ [CO1] [PO1]
 (i) decreases (ii) increases
 (iii) remains unchanged (iv) none of these
- c. In a single stage extraction process, 10 kg of pure solvent S (containing no solute A) is mixed with 30 kg of feed F containing A at a mass fraction $x_f = 0.2$. The mixture splits into an extract phase E and a raffinate phase R containing A at $x_B = 0.5$ and $x_R = 0.05$ respectively. The total mass of the extract phase is (in Kg) [CO1] [PO1]
 (i) 10 (ii) 6.89
 (iii) 8.25 (iv) 8.89
- d. Unbound moisture is that liquid which exerts an equilibrium vapour pressure _____ that of the pure liquid at the given temperature. [CO4] [PO1]
 (i) Less than (ii) More than
 (iii) Equal to (iv) Depends on solid
- e. Find the process [CO2] [PO1]
- Hot water \Rightarrow Sugar beet \Rightarrow Sugar
- (i) Extraction (ii) Leaching
 (iii) Evaporation (iv) None of the mentioned
- f. Which of the following forces is involved in chemical adsorption? [CO3] [PO1]
 (i) Van der waals force (ii) Magnetic force
 (iii) Gravitational force (iv) Electromagnetic force
- g. The removal of soluble materials from the solid is known as _____ [CO2] [PO1]
 (i) Decoction (ii) Extraction
 (iii) Elution (iv) None of the mentioned
- h. Which of the following is known as mother liquor? [CO3] [PO1]
 (i) Solvent (ii) Solute
 (iii) Solution (iv) Filtrate
- i. Crystallization is based on the difference in _____ [CO4] [PO1]
 (i) melting point (ii) boiling point
 (iii) solubility (iv) pressure
- j. Adsorbent used for dehydration of air or other gases is [CO3] [PO1]
 i. Bone char ii. Silica gel
 iii. Activated alumina iv. Activated charcoal

PART – B: (Short Answer Questions)**(2 x 10 = 20 Marks)**Q.2. Answer ALL questions

- | | | |
|--|-------|-------|
| | [CO#] | [PO#] |
| a. What is the advantage of multistage counter-current and cross-current operation? | CO1 | PO1 |
| b. What are type I and type II liquid system? | CO1 | PO1 |
| c. Define decoction and lixiviation in leaching. | CO2 | PO1 |
| d. What are miscella and marc? | CO2 | PO1 |
| e. A wet solid is to be dried from 80% to 5% moisture, wet basis. Compute the moisture to be evaporated per 1000kg of dried product. | CO4 | PO2 |
| f. What are the advantages of continuous drying over batch drying? | CO4 | PO1 |
| g. Write the application of spray dryer. | CO4 | PO1 |
| h. Write the factors affecting leaching rate. | CO2 | PO1 |
| i. Derive the mechanism of cation and anion exchanger. | CO3 | PO1 |
| j. Write the drawbacks of Agitated tank Crystalliser. | CO3 | PO1 |

PART – C: (Long Answer Questions)**(10 x 4 = 40 Marks)**Answer ALL questions

- | | | | |
|--|-------|-------|-------|
| | Marks | [CO#] | [PO#] |
| 3. a. A 2000 kg of pyridine-water solution, 50% pyridine is to be extracted with an equal amount of chlorobenzene. The raffinate from 1st extraction is to be re-extracted with a weight of solvent equal to raffinate weight and so on. Determine theoretical stages required and total quantity solvent required to reduce the pyridine concentration to 2%. | 10 | CO1 | PO2 |

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

(OR)

- | | | | |
|---|---|-----|-----|
| b. 1000 kg/hr of a nicotine-water solution containing 1% nicotine is to be extracted with kerosene to reduce the nicotine content to 0.1%. Water and kerosene are immiscible solvents. What is the minimum solvent requirement, kg/hr? If 1150kg/hr of solvent is used, how many theoretical stages are required? | 6 | CO1 | PO2 |
|---|---|-----|-----|

x'	0	0.00101	0.00246	0.00502	0.00998	0.0204
y'	0	0.00087	0.00196	0.00456	0.00913	0.0187

- | | | | |
|--|----|-----|-----|
| c. With a neat sketch describe the construction, working principle and application of RDC. | 4 | CO1 | PO1 |
| 4. a. Vegetable oil is to be extracted from vegetable oil seeds using ether as a solvent. 100kg of oil seed contains 20% of oil. Amount of ether used in each stage is 30kg. The equilibrium data table is as below. | 10 | CO2 | PO2 |

y	0	0.1	0.2	0.3	0.4	0.5	0.6
N	3.57	2.94	2.5	2.13	1.82	1.51	1.25

Calculate the different compositions for 3-stage cross current operation. Also determine the amount of oil extracted from vegetable oil seeds.

(OR)

- b. Describe about Rotocel extractor in details with neat sketch. 6 CO2 PO1
- c. Describe about CCD in details with neat sketch. 4 CO2 PO1
5. a. The equilibrium water adsorbed by a silica gel in contact with moist air varies with the humidity of air, as: $Y=3.5 \times 10^{-2}X$. 10 CO3 PO2

Where X= kg water adsorbed/kg of dry gel, Y= humidity of air, kg moisture/kg dry air.

0.5kg silica gel containing 6%(dry basis) adsorbed water is placed in a collapsible vessel in which there are 9m³ of moist air, the partial pressure of water being 15mmHg. The total pressure and temperature are kept at 1atm and 298K. Calculate the amount of water picked up from the moist air in the vessel by silica gel.

(OR)

- b. Describe in details about Swanson Walker Crystallizer. 6 CO3 PO1
- c. Explain Meir's supersaturation theory. 4 CO3 PO1
6. a. 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 m²/40kg dry weight. The critical moisture content is 18% on dry basis and the constant drying rate is 0.32 kg/(m².hr). For the falling rate period, the following data are available. 10 CO4 PO2

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

(OR)

- b. With suitable plot, explain the rate of drying curve. 5 CO4 PO1
- c. Describe in details about drum dryer. 5 CO4 PO1

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