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B. E / B. TECH.DEGREE EXAMINATION, MAY 2023

Sixth Semester

CH18601 – MASS TRANSFER II

(Chemical Engineering)

Regulation 2018

(Graph Sheet shall be Provided)

TIME:3 HOURS

MAX. MARKS: 100

- CO1** Determine the number of theoretical stages in absorption tower.
- CO2** Evaluate different types of distillation process.
- CO3** Apply Mass Transfer concepts in Liquid Liquid Extraction.
- CO4** Assess batch and continuous leaching process.
- CO5** Analyse different types of separation process.

PART- A(10x2=20Marks)

(Answer all Questions)

	CO	RBT LEVEL
1. List any two examples of absorption process.	1	2
2. Relate individual and overall mass transfer coefficients based on gas phase.	1	2
3. State the significance of relative volatility in distillation process.	2	2
4. List the assumptions of McCabe Thiele method.	2	2
5. Illustrate the significance of distribution coefficient in LLE process.	3	2
6. State any one use of pulsed column and Bollman extractor.	3	2
7. Identify the factors affecting the Leaching process.	4	2
8. Show the effects of polarity of solvent in extracting the solute during Leaching process.	4	2
9. Differentiate between adsorbent and adsorbate.	5	2
10. Outline the principle of Electro dialysis process.	5	2

PART- B (5x 14=70Marks)

	Marks	CO	RBT LEVEL
11. (a) It is desired to recover 95% ammonia from air-ammonia mixture containing 5% ammonia at 20°C and at 1 atm by scrubbing with water in a tower packed with 2.5 cm rasching rings. If the gas flow rate is 30 kg/m ² min at the inlet and liquid flow rate is 1.5 times the minimum. Estimate the height of packed tower for counter current operation. Absorption is assumed to be isothermal. The equilibrium relation is given by $y = 0.76 x$, where y, x are gas and liquid phase composition of ammonia in mole fraction respectively. The overall mass transfer coefficient is 1.1 kg mole/m ³ atm.min	(14)	1	5

		(OR)			
(b) Construct the relationship between the packed height of the absorption column with respect to gas and liquid phase mass transfer co-efficient.	(14)	1	5		
12. (a) (i) Derive Rayleigh's equation with differential distillation diagram setup.	(9)	2	4		
(ii) Analyze the effect of Reflux ratio on cost.	(5)	2	4		
(OR)					
(b) (i) Analyze about the McCabe-Thiele method with graphical steps for obtaining theoretical plates including assumptions, stepwise procedure and Limitations.	(9)	2	4		
(ii) Analyze the q value for various thermal conditions with a neat diagram.	(5)	2	4		
13. (a) 1000 kg/hr of an acetone-water mixture containing 20% by weight of acetone is to be counter-currently extracted with trichloroethane. The recovered solvent to be used is free from acetone. The water and trichloroethane are insoluble. If 90% recovery of acetone is desired estimate the number of stages required if 1.5 times the minimum solvent is used. The equilibrium relationship is given by $y = 1.65x$, where x and y are weight fractions of acetone in water and trichloroethane respectively.	(14)	3	3		
(OR)					
(b) Write the procedure to calculate the number of stages for counter current Multi-stage Liquid-Liquid extraction process.	(14)	3	3		
14. (a) Oil is to be extracted from meal by means of benzene using a continuous counter current extraction unit. The unit is expected to treat 1000 kg of meal (based on completely exhausted solid) per hour. The untreated meal contains 365 kg of oil and 30 kg of benzene. The solvent used contains 14 kg of oil and 590 kg of benzene. The exhausted solids are to contain 55 kg of unextracted oil. The experimental data on the extraction of oil from the meal by means of benzene at a given operating temperature are as follows	(14)	4	5		

Solution composition, kg oil/kg solution	Solution retained (in underflow) Kg solution/kg solids
0	0.500
0.1	0.505
0.2	0.515
0.3	0.530
0.4	0.550
0.5	0.571
0.6	0.595
0.7	0.620

Determine the number of ideal stages required.

(OR)

- (b) By extraction with kerosene two tones of waxed paper per day is to be dewaxed in a continuous countercurrent extraction system. The waxed paper contains 25% paraffin wax by weight and 75% paper pulp. The pulp which retains the unextracted wax must not contain over 0.2 kg of wax/100 kg of wax free pulp. The kerosene used for extraction contains 0.05 kg of wax/100 kg of wax free kerosene, experiments show that pulp retains 2 kg of kerosene per kg of wax free pulp. The extract from battery contains 5 kg of wax/100 kg of wax free kerosene. Determine the number of stages needed. (14) 4 5
15. (a) A solid adsorbent is used to remove colour impurity from an aqueous solution. The original value of colour on an arbitrary scale is 48. It is required to reduce this to 10% of its original value. Using the following data, find the quantity of fresh adsorbent used for 1500 kg of solution for (a) a single stage and (7) (7)

(b) a two-stage cross current operation

when the intermediate colour value is 24.

Kg adsorbent of solution	0	0.001	0.005	0.008	0.03	0.06
Equilibrium colour (y)	48	41	30	20	10.5	3.5

(OR)

- (b) (i) Analyze the principles of ion exchange techniques and its applications. (7) 5 4
- (ii) Write about various membrane techniques available for desalination process. (7) 5 4

PART- C(1x 10=10Marks)

(Q.No.16 is compulsory)

- | | Marks | CO | RBT LEVEL |
|--|-------|----|-----------|
| 16. Discuss the applications of absorption process in the abatement of pollution in Chemical Process industries. | (10) | 1 | 3 |