COURSE TITLE : MASS TRANSFER OPERATIONS II
COURSE CODE : 6072
COURSE CATEGORY : A
PERIODS/ WEEK : 5
PERIODS/ SEMESTER : 75
CREDIT : 5

TIME SCHEDULE

MODULE	TOPIC	PERIODS
1	Leaching	17
2	Liquid- Liquid Extraction	20
3	Crystallisation	20
4	Fractionation	18
TOTAL		**75**

COURSE OUTCOME:

SL.NO.	SUB	STUDENT WILL BE ABLE TO
1	1	Understand the importance of leaching operation
	2	Comprehend constructional details and working of leaching equipment
	3	Understand the theory behind Liquid –liquid extraction& working of extraction equipments
2	4	Analyse the problems behind the crystallization
	5	Appreciate the operations of different crystallizers
3	6	Understand the basic principle of fractionation
	7	Appreciate the working of rectification column

SPECIFIC OUTCOMES:

MODULE- I

1.1.0 Understand the importance of Leaching.

1.1.1 Define the following terms. (1) Leaching (2) Elutriation or Elution (3) Lixivation.
1.1.2 Differentiate between leaching (solid –liquid extraction) and liquid – Liquid extraction.
1.1.3 Explain the factors affecting rate of solid –liquid extraction.
!.1.4 Classify the solid –liquid extraction system.
1.1.5 List the applications of leaching.
1.1.6 Differentiate between batch and continuous leaching operations.
1.1.7 Explain heap leaching.

1.2.0 Understand the constructional details and working of extractors.

1.2.1 Explain the working of percolation tank.
1.2.2 Explain the working of Pachuca extractor.
1.2.3 Explain shank system.
1.2.4 Describe the working of agitated vessel with a neat sketch.
1.2.5 Explain the process continuous counter current decantation.
1.2.6 Explain the constructional details and working of Boll man extractor.
1.2.7 Explain the working of a Rotocel extractor with a neat sketch.
1.2.8 Describe the working of a Kennedy extractor with a neat sketch.
1.2.9 Explain the working of Bonotto extractor.
1.2.10 Explain the super critical fluid extraction.

MODULE – II

2.1.0 Understand the importance of Liquid –Liquid extraction.

2.1.1 Differentiate between Distillation and Extraction.
2.1.2 Explain the principles of liquid – liquid extraction.
2.1.3 Field of application of Liquid – Liquid extraction.
2.1.4 Explain triangular diagram for Liquid – liquid extraction.
2.1.5 Define distribution Co-efficient and selectivity
2.1.6 Define the terms Raffinate and Extract.

2.2.0 Understand the construction details and working of liquid-liquid extractors

2.2.1 Describe the working of spray and packed extraction towers with a sketch.
2.2.2 Explain the working of Mixer settler.
2.2.3 Explain the constructional details and working of Rotating Disk contactor and pulse column .
2.2.4 List the important factors to be considered for selecting a suitable solvent.

MODULE – III

3.1.0 Understand the Crystallization in Chemical Industries.

3.1.1 Define Crystallization.
3.1.2 Differentiate between the Evaporation and Crystallization.
3.1.3 Explain the applications of crystallization operation.
3.1.4 Describe the principles of crystallization.
3.1.5 Draw and explain the equilibrium curve for a solid-liquid system.
3.1.6 Define the yield of crystals.
3.1.7 Explain the following terms solubility, saturation, super saturation and rate of crystal growth.
3.1.8 Explain four methods of super saturation.
3.1.9 Derive the material balance equation and solve the simple problems .
3.1.10 Explain the constructional details and working of the tank crystallizer, cooling crystallizer, evaporator crystallizer, Swenson Walker Crystallizer, Krystal crystallizer.
3.1.11 Explain the phenomenon of caking
3.1.12 Define critical humidity and explain the effect of humidity on storage

MODULE- IV

4.1.0 Comprehend the principle of rectification.

- 4.1.1 Draw the layout of distillation column and accessories.
- 4.1.2 Explain the functions re-boiler and condenser in a distillation column.
- 4.1.3 List the applications of rectification.
- 4.1.4 Define an ideal plate.
- 4.1.5 Prepare material balance and heat balance equation for an ideal plate.
- 4.1.6 Define constant molal over flow and constant molal vaporizations.
- 4.1.7 Explain the McCabe & Thiele method.
- 4.1.8 Derive an equation for rectifying line Derive an equation for stripping line.
- 4.1.9 Define 'q' factor and derive equation for 'q' line.
- 4.1.10 Explain the values of 'q' based on five different feed conditions.
- 4.1.11 Explain the procedure for solving problems using McCabe and Thiele method.
- 4.1.12 Find the number of theoretical plates required for a given separation and locate the feed plate graphically, and calculate the plate efficiency.
- 4.1.13 Explain minimum reflux and total reflux.
- 4.1.14 Estimate graphically the minimum reflux ratio and the minimum number of theoretical plates for rectification.
- 4.1.15 Differentiate between extractive and azeotropic distillation.
- 4.1.16 Explain the applications of azeotropic and extractive distillation.
- 4.1.17 Draw and explain molecular distillation still.

4.2.0 Understand the construction of equipments used for various distillation methods.

- 4.2.1 Describe the construction details of bubble cap columns.
- 4.2.2 Explain the construction of sieve plate, kittle plate and valve plate.
- 4.2.3 Define the following terms which affect the efficiency of plate column
  1. Flooding
  2. Entrainment
  3. Weeping
  4. Dumping
  5. Corning

CONTENT DETAILS

MODULE I

Definition-Applications of leaching – batch and continuous – heap leaching – percolation tanks – Pachuca extractor - shank system – agitated vessel – continuous counter current decantation – Boll man extractor – Rotocel extractor – Kennedy extractor – Bonotto extractor – super critical fluid extractor.

MODULE II

Definition – Application of Liquid – Liquid extraction – Raffinate – Extract – Triangular diagram – Selectivity – Distribution coefficient- Selection of solvent for extraction- construction details of mixer settlers – Spray tower - packed towers –Sieve tray tower – Rotating disk contactor-Pulse column.

MODULE III

Application – equilibrium curve for a solid – liquid system – yield of crystals – solubility –saturation – super saturation–crystal growth – methods of super saturation – material balance equation- simple problems -Constructional details of crystallizer – Agitated tank crystallizer – Swenson walker crystallizer - evaporator crystallizer - Caking of crystals .

MODULE IV

Rectification-Definition- principle–application-Fractionating Column–Mechanism fractionation - Concept of 'q' - Derivation of q line - Upper operating line – lower operating line – design of a fractionating column by Mccabe-Thiele method - bubble cap column – valve tray – kittle tray- Azeotropic distillation- Extractive distillation - molecular distillation.

REFERENCE

McCabe and Smith	-	Unit Operations
Treybal.R.E	-	Mass Transfer Operations
P.Chathopadhya	-	Unit Operations of Chemical Engg., Vol. – I
Surya Narayana	-	Mass Transfer Operations
K A Gavhane	-	Unit Operations. II