COURSE TITLE : CHEMICAL ENGINEERING
COURSE CODE : 5083
COURSE CATEGOR : E
PERIODS/WEEK : 4
PERIODS/SEMESTER : 72
CREDITS : 4

TIME SCHEDULE

MODULE	TOPIC	PERIODS
I	Units and dimensions. Introduction to Chemical Engineering	18
II	Understand the mechanism of heat transfer By Conduction and convection	18
III	Understand Material balances in unit operations	18
IV	Understand the Basic Principles of Distillation	18
	TOTAL	**72**

OBJECTIVES

MODULE-I

1.1.0 Units and dimensions

1.1.1 Explain the various systems of units
1.1.2 Explain the difference between fundamental and derived units
1.1.3 List the fundaments and derived units and SI systems
1.1.4 List the commonly used prefixes and suffixes used in SI systems
1.1.5 Solve problems in conversions of units
1.1.6 Explain the concepts of dimensionless groups
1.1.7 Calculate, using chemical formule, the mass, volume, mole relation, molality, molarity, normality
1.1.8 Define gm atom, kg atom, gm mole, jg mole
1.1.9 Solve problems using atomic weight molecular weight and equivalent weight
1.1.10 Solve problems using mass, volume relationship for gaseous substances
1.1.11 Explain density and specific gravity and specific gravity scales
1.1.12 Solve problems in density and specific gravity
1.1.13 Explain various chemical process in the field of chemical engineering

1.2.0 Introduction to Chemical Engineering

1.2.1 Explain the concept of unit operation and unit process
1.2.2 List the examples of unit operation and unit process
1.2.3 Explain the uses of flow diagram in chemical industries
1.2.4 Prepare flow diagrams for simple process

MODULE-II

2.1.0 Understand the mechanism of heat transfer by conduction

2.1.1 Define conduction

2.1.2 Apply rate equation for heat flow
2.1.3 Derivation of conduction equation for plane well
2.1.4 Define and explain Fourier's law of thermal conduction
2.1.5 Solve the simple problem apply the basic equation of thermal conduction
2.1.6 Define thermal conductivity
2.1.7 Distinguish between steady slate and unsteady state conduction
2.1.8 Derive the equation to calculate heat transfer through composite plane wall
2.1.9 Derive the equation to calculate heat transfer through cylindrical wall
2.1.10 Derive the equation to calculate heat transfer through spherical wall
2.1.11 Solve the problems using equation derived
2.1.12 Explain the different type of insulating materials
2.1.13 Explain the characteristic of good insulating materials

2.2.0 Understand the heat transfer by Convection

2.2.1 Explain convection
2.2.2 Explain the film concept in heat convection
2.2.3 Explain the temperature gradient in forced convection
2.2.4 Define and explain individual heat transfer coefficient
2.2.5 Explain the factors affecting the heat transfer coefficient

MODULE-III

3.1.0 Understand Material balances in unit operations

3.1.1 State law of Conservation of mass
3.1.2 Define the various unit operations like evaporation, absorption leaching, extraction.
3.1.2.1 Explain horizontal tube and vertical tube evaporator, long vertical evaporator, multiple effect evaporator-forward & backward feed.
3.1.2.2 Comparison of Absorption and Distillation, Packed Column for Absorption – Tower packings – types and characteristics, Flooding and Channeling in Packed Columns.
3.1.2.3 Define Co current and Counter current Extraction, Extraction equipments – Mixer settlers (Batch & continuous only), Perforated plate tower for continuous counter current extraction, Horizontal and Vertical Bollman Extractor to extract Cotton seed oil.
3.1.3 Solve material balance problems involving unit operations like, Evaporation, Distillation, Crystallization, Absorption, Leaching, Extraction
3.1.4 State key component
3.1.4.1 Solve material balance equations using key component
3.1.5 Solve material balance problems involving bypass and recycle

MODULE-IV

4.1.0 Understand the Basic Principles of Distillation

4.1.1 List the applications of distillation operation
4.1.2 Define the terms less volatile, more volatile, low boiling and high boiling
4.1.3 Express the composition of mixtures of liquid and vapour
4.1.4 Define Raoult's law
4.1.5 Distinguish between ideal and non ideal solutions
4.1.6 Calculate compositions in terms of mole fractions
4.1.7 Construct the vapour – liquid equilibrium diagram for a binary mixture
4.1.8 Calculate vapour liquid equilibrium data applying Raoult's law
4.1.9 Derive an equation for relative volatility
4.1.10 Problems using the above derived equation

4.1.11 Define ‘azeotrope’
4.1.12 Explain maximum and minimum boiling azeotrope with suitable examples
4.1.13 List the various methods of distillation
4.1.14 Explain simple distillation
4.1.15 Derive and verify Rayleigh’s equation for simple distillation
4.1.16 Explain steam distillation
4.1.17 List the advantages and applications of steam distillation
4.1.18 Fractional distillation, Reflux ratio, Total reflux and minimum reflux ratio, Batch Distillation, various plates used for Liquid flow patterns over tray.
4.1.19 Packed Column for continuous distillation, Plate efficiencies

COURSE CONTENT

MODULE-I

Units and dimensions

Units and dimensions, conversion of units, dimesnsionless group, chemical formulae, mass relation, chemical reactions, gm atom, gm mole, kg atom, kg mole, Relation between mass and volume of gaseous substances . Method of expressing compositions of mixture of solids, liquids and gases, Density, specific gravity and specific gravity scales- Introduction to Chemical Engineering-concept of unit operation and unit process – flow diagrams-Pilot plant study.

MODULE-II

Heat Transfer

Heat transfer by conduction in solids – steady state and unsteady state flow – definition – units of heat flow-Fourier's law of conduction – Rate equation for heat flow – steady state heat flow conduction through single wall – derivation of equation and simple problems – Thermal conductivity – units-Steady state conduction through composite wall in series derivation of equation and problems-Steady state conduction through cylindrical wall and spherical wall derivation – problems

Theory of convection – film concept of heat transfer temperature gradient in forced convection –

MODULE-III

Material Balances in unit operations.

Various unit operations – Evaporation, Absorption, leaching, Extraction – Types of evaporators – Extraction equipments – Material balances equations – Key component – Material balances – Problem involving mixing, leaching, crystallization, evaporation, distillation, absorption – simple problem involving bypass and recycle.

MODULE-IV

Distillation

Distillation as an interphase mass transfer – industrial application – definition of terms – less volatile, more volatile, low boiling, high boiling – vapour – liquid equilibrium diagrams and their importance. Ideal and non-ideal solutions – Raoult's law – calculation of X-Y data using Raoult's law. Azeotropes –maximum and minimum boiling – volatility and relative volatility – calculation of relative volatility of a binary mixture. Types of distillation – equilibrium – simple distillation, steam distillation – Fractional distillation, Reflux ratio – Total Reflux and Minimum reflux ratio – Batch distillation.

REFERENCE

1. Process Calculations for chemical engineers - Chem. Engg., Edn Development Centre, IIT Madrass
2. Process Calculations - V.Venkataramani,N.Anantharaman
3. Introduction to Chemical Engineering - Water.L.Badge
4. Heat and Mass Transfer - R.K.Rajputh
5. Unit Operation – I - T.T.T.I. Kalamassery