

GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN CHEMICAL ENGINEERING

SEMESTER: V

Subject Name: **Mass Transfer-II**

Sr. No.	Course Content
1.	Equipment for Gas Liquid Operations: 1.1 Need of equipment 1.2 Gas dispersed 1.2.1 Sparged vessels 1.2.2 Mechanically Agitated Vessels 1.2.3 Tray towers – Perforated tray towers, Bubble cap tray tower, Valve tray tower 1.2.3.1 Various types of trays 1.2.3.2 Operating problems in tray tower 1.2.3.3 Efficiency in tray tower 1.3 Liquid dispersed 1.3.1 Venturi scrubbers 1.3.2 Wetted wall column 1.3.3 Spray tower 1.3.4 Packed tower & its operating problems 1.3.5 Various types of pickings & packing arrangement
2.	Distillation: 2.1 Distillation and a separation method and versatility of its applications 2.2 Vapor Liquid Equilibria 2.2.1 Constant pressure and constant temperature equilibria 2.3 Relative volatility 2.4 Raoult's law and its use, Henry's law and its use 2.5 Maximum and minimum boiling azeotrops 2.6 Flash vaporization with material balance and numerical based on direct use of formula 2.7 Differential distillation with derivation of Rayleigh's equation and calculation of product 2.8 Continuous rectification- Binary systems 2.8.1 The fractionation operation 2.8.2 Overall Enthalpy Balances 2.9 Multistage Tray Towers-McCabe & theile method for enriching and stripping section 2.9.1 Introduction of Feed & Location of the feed tray 2.9.2 Total reflux ratio, minimum reflux ratio, Optimum reflux ratio 2.9.3 Calculations of product rates, minimum reflux ratio and number of trays 2.10 Use of open stream 2.11 Types of Distillation • Steam distillation • Vacuum and molecular distillation • Azeotropic and extractive distillation 2.12 Various types of reboilers and their use

3.	Humidification: 3.1 Vapor-liquid Equilibrium and Enthalpy for a pure substance 3.1.1 Vapor-pressure curve 3.1.2 Enthalpy 3.2 Vapor-gas mixtures 3.2.1 Absolute Humidity 3.2.2 Saturated vapor-gas mixtures 3.2.3 Unsaturated vapor-gas mixtures 3.2.4 Concept of Dry bulb temperature, Dew point, Wet bulb temperature (laboratory concept) Humid volume, humid heat, adiabatic saturation temperature 3.2.5 Calculations of absolute humidity, relative saturation, percentage saturation 3.3 The system Air-Water, Psychometric charts 3.4 Gas-Liquid contact operations 3.4.1 Classification of Adiabatic operations 3.4.2 Classification of non-adiabatic operations 3.5 Dehumidification of Air-water Vapor 3.6 Equipments 3.6.1 Principles and types of cooling towers 3.6.2 Spray chambers 3.6.3 Spray ponds
4.	Drying: 4.1 Equilibrium 4.1.1 Insoluble solids 4.1.2 Hysteresis 4.1.3 Soluble solids 4.1.4 Definitions and calculation of Moisture content, Equilibrium and free moisture, Bound and un bound moisture 4.2 Classification of drying operation 4.3 Classification of drying equipment 4.4 Construction and working of following equipment • Tray drier • Tunnel drier • Vacuum drier • Rotary vacuum drier • Spray drier • Fluidized bed drier • Pneumatic drier 4.5 Freeze drying 4.6 Drying test and derivation of equation for drying time for constant rate period and falling rate period 4.7 Numerical for drying time
5.	Adsorption & Ion-Exchange: 5.1 Adsorption 5.1.1 Definition and industrial application 5.1.2 Types of adsorption 5.1.3 Characteristics of adsorbents, nature of commonly used adsorbents 5.2 Adsorption Equilibria

	5.2.1 Single gases and vapors 5.2.2 Adsorption hysteresis 5.3 Effect of temperature on adsorption 5.4 Heat of adsorption 5.5 Liquids 5.5.1 Adsorption of solute from dilute solution 5.5.2 The Freundlich's equation 5.5.3 Adsorption from concentrated solutions 5.6 Material balance and Freundlich's equation for single stage operation and multistage cross-current operation 5.7 Ion-Exchange 5.7.1 Principles 5.7.2 Application 5.7.3 Equilibria 5.7.4 Rate of ion exchange 5.8 Higgins contactor
6.	Crystallization: 6.1 Crystal geometry 6.2 Equilibria and yields 6.3 Super saturation and methods to get it 6.4 Nucleation 6.5 Crystal growth 6.6 Crystallization Equipment 6.6.1 Vacuum crystallizer 6.6.2 Swenson walker crystallizer 6.6.3 Krystal Crystallizer 6.6.4 Draft tube-baffle crystallizer 6.7 Meir's theory 6.8 Crystallization with and without seeding 6.9 Simple Calculations of crystal yield 6.10 Caking of crystals & prevention methods

Laboratories:

1. Study of Distillation Model
2. Vacuum Distillation
3. Differential Distillation
4. Steam Distillation
5. Measurement of moisture content (Dry and wet basis)
6. Measurement of wet and dry bulb temperature
7. Drying in vacuum drier
8. Measurement of drying time for sand in constant rate and falling rate region
9. Drying with and without air circulation
10. Adsorption of moisture by silica gel
11. Vacuum crystallization
12. Crystallization with and without seeding
13. Study of Cooling tower model

Reference Books:

1. Mass transfer operations, Robert E Treybal.
2. Unit operations in chemical engineering, Mc Cabe and smith.
3. Introduction to chemical engineering, Walter L Badger & Julius T Banchero.