

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. SEMESTER: VI

Bio-Technology

Subject Name: **Principles of Process Engineering – III**

Subject Code: **160405**

Teaching Scheme				Evaluation Scheme		
Theory	Tutorial	Practical	Total	University Exam (Theory) (E)	Mid Sem Exam (Theory) (M)	Practical (I)
3	0	3	6	70	30	50

UNIT I Humidification

Sr. No	Course Content	Total Hrs.
1.	Vapor-liquid Equilibrium and Enthalpy for a pure substance, Vapor-gas mixtures, Absolute Humidity, Saturated vapor-gas mixtures, Unsaturated vapor-gas mixtures, Concept of Dry bulb temperature, Dew point, Wet bulb temperature (laboratory concept), Humid volume, Humid heat, Adiabatic saturation temperature, Calculations of absolute humidity, Relative saturation, Percentage saturation, The system Air-Water, Psychometric charts, Gas-Liquid contact operations	7

UNIT II Adsorption & Ion-Exchange

Sr. No	Course Content	Total Hrs.
1.	Adsorption, Definition and industrial application, Types of adsorption, nature of commonly used adsorbents, Adsorption Equilibria, Single gases and vapors, Adsorption hysteresis, Effect of temperature on adsorption, Heat of adsorption, Adsorption of solute from dilute liquid solution, The Freundlich's equation, Adsorption from concentrated solutions, Material balance and Freundlich's equation for single stage operation and multistage cross-current operation, Ion-Exchange, Principles, Application, Equilibria and Rate of ion exchange	9

UNIT III Distillation

Sr. No	Course Content	Total Hrs.
1.	Binary System : Introduction, Vapor-liquid equilibrium, P-X-Y T-X-Y diagrams, concept of volatility and effect of P and T on equilibrium data, Ideal solutions, Raoult's Law as applied to distillation operations, Deviation from ideality minimum and maximum boiling azeotropic mixtures, Enthalpy concentration diagrams, their characteristics. Flash distillation, stream	16

	distillation, simple distillation, continuous rectification, Batch fractionation etc., Determination of number of stages, by Ponchon and Savarit method and McCabe Thiele method, multi tray towers, concept of minimum total and optimum reflux ratio, Reboilers, use of open stream multiple feeds, partial condensers, cold hot circulating reflux etc.	
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UNIT IV: Drying

Sr. No	Course Content	Total Hrs.
1.	Equilibrium relationship, Drying operations and equipments, Equilibrium moisture, Bound moisture, unbound moisture, free moisture etc., Batch drying, rate of drying, time of drying, Cross-circulation drying, concept of HtOG and NtOG, Drying at low temperature, freeze drying etc, Mechanism of various drying operations should be discussed in detail continuous drying equipments-Tunnel dryers, Rotary dryers, Spray dryers etc.,	10

UNIT V: Crystallization

Sr. No	Course Content	Total Hrs.
1.	Saturation, nucleation, crystallization rate, effect of impurities, effect of temperature on solubility, caking of crystals, Batch crystallizes, continuous crystallizers.	6

List of Experiments:

1. To study and verify the Freundlich's Adsorption Isotherm Adsorbing Oxalic Acid and Charcoal.
2. To study the Characteristics of Adsorption for Silica Gel.
3. To find out Crystal Yield without Seeding.
4. To study the Crystallization of Boric acid and to find Percentage Yield at Different Temperature.
5. To measure the vapor pressure of acetone and calculate latent heat of vaporization.
6. To study the humidification operation and calculate all the terminology's used for air – water contact operation.
7. To determine pressure drop data and values of Kg for various air and liquid velocities in a counter cooling tower.
8. To Verify Rayleigh's Equation for Differential Distillation.
To plot Fraction of Charge of Distillates V/S Residue Components & temperature of distillations.
9. To verify the Equilibrium Relationship for n-Butanol Water System.
10. To verify Henry's Law for Steam Distillation.
11. To Find Out The Critical Moisture Content Of A Given Material & Find Out Its Equation For Constant And Filling Rate Period.
12. To study the Construction and Working of Tray Drier.
13. To study the Construction and Working of a Rotary Drier.

Practical and Term Work:

Experiments related to Distillation, Humidification, Adsorption, Drying, Crystallization etc,

Text Book:

1. Mass Transfer Operations, R.E. Treybel, McGraw Hill Publication

Reference Book:

1. Chemical Engg. Vol.II Richardson and Coulson, Pergamon Press.