

# GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. SEMESTER: VI

Chemical Engineering

Subject Name: **Mass Transfer Operation-II**

Sr. No	Course Content	Total Hrs.
1.	<b>Distillation:</b> Binary System: Introduction, Vapor-liquid Equilibria, $P$ - $x$ - $y$ $T$ - $x$ - $y$ 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, steam distillation, simple distillation, continuous rectification, Batch fractionation etc., Determination of number of stages by Ponchon and Severit method and McCabe-Thiele method, Concept of minimum, total and optimum reflux ratio, Reboilers, Use of open steam, , Partial condensers, cold hot circulating reflux etc. Azeotropic Distillation, Extractive Distillation	25
2.	<b>Humidification and dehumidification:</b> Vapour liquid Equilibria, Enthalpy of saturated and unsaturated vapour liquid mixtures, adiabatic saturation curves, concept of wet bulb and dry bulb temp. Lewis relation, water-cooling with air, Dehumidification of air-water vapour, Various types of cooling tower & their selection criteria, wet bulb approach & range of cooling tower, Cooling tower fillings, Calculations of make-up water requirement of cooling tower.	10
3.	<b>Adsorption and ion exchange:</b> Types of adsorption, Nature of adsorbents, adsorption Equilibria, adsorption of single gas/vapour from gaseous mixture, dilute and concentrated liquid solutions, fixed bed, ion-bed adsorbers, principles of ion exchange. Equilibria and rate of ion exchange.	09
4.	<b>Drying:</b> Equilibrium relationship, Drying operations and equipments, Equilibrium moisture, Bound moisture, unbound moisture, free moisture etc., Hysteresis in Drying, Batch drying, rate of drying, time of drying, Cross-circulation drying, concept of $NoG$ and $HoG$ , Drying at low temperature, Freeze drying etc. Mechanism of various drying operations, Batch & continuous drying equipments- Tray dryer, Tunnel dryer, Rotary dryers, Spray dryers, Fluidized bed dryer, etc.	10

**Practicals:**

Experiments based on the above topics

**Text Book:**

“Mass transfer operation” by R.E.Treybal, Mc-Graw Hill international

**References Books:**

- 1 “Mass Transfer” by Sherwood, Pigford & Wilke, Mc-Graw Hill international
- 2 “Chemical Engineering”, Volume-2, 4<sup>th</sup> edition by Coulson & Richardson
- 3 Perry’s Chemical Engineers handbook, 7<sup>th</sup> edition by Perry & Green, Mc-Graw Hill international
- 4 Unit Operations of Chemical Engg. By W.L. McCabe , J. C. Smith & Harriott, 6<sup>th</sup> edition Mc-Graw Hill international