

Subject: Separation Processes

CHE-		4CH	
341 1ST Semester	Separation processes	Theory (3) Lab (1)	
Pre-req.	Mass Transfer	Category	Foundation Course
Course Contents as per PEC Guidelines 2023-2024			
• Humidification and cooling towers • Humidification terms, wet-bulb and adiabatic saturation temperature, Humidity data for the air-water system. Temperature-Humidity chart, Enthalpy- Humidity chart Determination of humidity, humidification and dehumidification. Cooling tower design: Basic principles, types, features and operation of various cooling towers. • Crystallization • Growth and properties of crystals, saturation and nucleation, impurities, Effect of temperature on solubility, Principles of construction operations. • Membrane separation processes • Principles, applications, and equipment. • Drying • General principles, Rate of Drying, Diffusion and Capillary theory of drying, Classification and selection of dryers(Tray, tunnel, rotary, drum, spray, pneumatic, fluidized beds, turbo-shelf, disc and centrifuge dryers), Solvent drying, Superheated steam drying, Freeze drying, Flash drying. • Liquid-liquid extraction • Introduction, Extraction Processes, Equilibrium data, Calculation of the number of theoretical stages for various cases of counter-current and concurrent operations. • Leaching • General principles, Factors influencing the rate of extraction, Mass transfer in leaching operations, Equipments for leaching, Calculation of the number of stages by graphical methods. • Introduction to separation processes. • Cooling tower design; Alternative sinks for waste heat, Design of equipment based on worst case scenarios. Water and air based systems, Environmental effects. • Crystallization rate, Solubility and phase diagrams, Fractional crystallization, Caking Crystallization • Particle-recycle dryers, The drying of gases. • Ion exchange: Principles, applications, and equipment.			

Weekly plan/ Reference Books	
1	Introduction to separation processes. Humidification and cooling towers Humidification terms, wet-bulb and adiabatic saturation temperature, Humidity data for the air-water system. Temperature-Humidity chart, Enthalpy-Humidity chart Determination of humidity, humidification and dehumidification. Cooling tower design: Basic principles, types, features and operation of various cooling towers.
2-3	Crystallization Growth and properties of crystals, saturation and nucleation, impurities, Effect of temperature on solubility, Principles of construction operations.
4	Membrane separation processes Principles, applications, and equipment.
5	Drying General principles, Rate of Drying, Diffusion and Capillary theory of drying, Classification and selection of dryers (Tray, tunnel, rotary, drum, spray, pneumatic, fluidized beds, turbo-shelf, disc and centrifuge dryers), Solvent drying, Superheated steam drying, Freeze drying, Flash drying.
6	Liquid-liquid extraction Introduction, Extraction Processes, Equilibrium data, Calculation of the number of theoretical stages for various cases of counter-current and concurrent operations.
7-8	Leaching General principles, Factors influencing the rate of extraction, Mass transfer in leaching operations, Equipment for leaching, Calculation of the number of stages by graphical methods.
9-10	Mid Term Exams
11-12	Cooling tower design: Alternative sinks for waste heat, Design of equipment based on worst case scenarios. Water and air-based systems, Environmental effects.
13	Crystallization rate, Solubility and phase diagrams, Fractional crystallization, Caking Crystallization Particle-recycle dryers, The drying of gases.
14	Ion exchange: Principles, applications, and equipment
15-16	Adsorption (added in mass transfer) Introduction, the nature of adsorbents, Adsorption equilibrium, Adsorption from liquids, structure of adsorbents, Adsorption equipment and regeneration of spent adsorbents, Problems related to adsorption
17	Revision
18	End Semester Exam

TEXT AND REFERENCE BOOKS:

- McCabe Warren L., Smith Julian C., Harriott Peter "Unit Operations of Chemical Engineering" 7th Ed. 2005. McGraw-Hill Inc.
- Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-II, 5th Ed. 2002. The English Book Society and Pergamon Press.
- Incropera Frank P., De Witt David P. "Fundamentals of Heat and Mass Transfer" 3d Ed. 1990. John Wiley and Sons.
- Treybal Robert E. "Mass Transfer Operations", 1981, McGraw-Hill Book Company.
- Schweitzer, "Handbook of Separation Techniques for Chemical Engineers", 1979, McGraw-Hill Book Co.
- Coulson J.M., Richardson J.F. "Chemical Engineering" Vol-I, 1999. The English Book Society and Pergamon Press
- Alan S. Foust, Leonard A. Wenzel "Principles of Unit Operations" 2nd Ed. 1980. John Wiley & Sons.
- Diran Basmadjian. "Mass Transfer and Separation Process (Principles and Applications) CRC Press Taylor and Francis Group. 2007.
- Christie J. Geankoplis, "Transport Processes and Unit Operations", 4th Ed., 2003, Prentice Hall Professional Technical Reference. Hogen Olaf A., Watson Kenneth M. "Chemical Processes Principles". 2004, John Wiley and Sons & CBS Publishers.
- Chopy & Hicks, "Handbook of Chemical Engineering Calculations", 2nd Ed. 1994 McGraw-Hill Professional Publishing.

