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Department of Chemical Engineering	
Unit Operation (64362)	
Total Credits	**3**
major compulsory	
Prerequisites	P1 : Mass Transfer (64361) OR Mass Transfer Operations (64461)

Course Contents

This course covers the equilibrium principles and design calculations of several mass transfer-based chemical operations, such as distillation, solvent extraction, adsorption, crystallization, and humidification and cooling towers. Both single- and multiple-stage operations of these systems are studied.

	Intended Learning Outcomes (ILO's)	Student Outcomes (SO's)	Contribution
1	Apply mathematics, science and engineering principle to calculate operational parameters needed to different unit operation processes.	A	20 %
2	Formulate and solve expressions for different separation units such as heat balances, material balances and likewise	E	40 %
3	Ability to design a separation process to meet desired needs.	C	40 %

Textbook and/ or Refrences

Transport processes and unit operations,3rd edition, Christie J. Geankoplis, University of Minnesota, Prentice-Hall International, Inc.1993 ISBN 0-13-045253-X Ref: Robert E. Treybal mass-transfer operations McGraw-Hill international Editions

Assessment Criteria	Percent (%)
First Exam	20 %
Second Exam	20 %
Quizzes	10 %
Final Exam	50 %

Course Plan

Week	Topic
1_5	Introduction Chapter 9 Drying of process Materials 9.1 introduction and methods of drying 9.2 Equipment for drying 9.3 Vapor pressure of water and humidity 9.4 Equilibrium Moisture Content of material 9.5 Rate of drying 9.6 Calculation Methods of constant Rate drying period 9.7 Calculation Methods of falling Rate drying period 9.8 Combined Convection radiation and conduction 9.10 Equations for various types of dryers 9.12 Thermal processing ,sterilization and pasteurization of Biological materials First exam
6_11	Chapter 11. Vapor liquid equilibrium (VLE) VLE relations 640p Single stage equilibrium contact for Vapor/Liquid system Simple distillation methods Distillation with reflux and McCabe Thiele method Distillation and absorption tray efficiencies Fraction distillation Using enthalpy concentration method Second exam
12_15	Chapter 12 Liquid/liquid and fluid solid separation processes 12.1 Introduction to adsorption 12.2 Batch adsorption 12.3 design of fixed bed adsorption column 12.5 Single stage liquid/liquid extraction methods 12.6 Equipment for liquid/liquid extraction 12.7 continuous multistage counter current extraction 12.8 Introduction and equipment for liquid solid leaching 12.9 Equilibrium relations and single stage leaching 12.10 Counter current multistage leaching

16	Final exam