SRM UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF CHEMICAL ENGINEERING

COURSE PLAN

Course Code	: CH0307	Course Title	: Mass transfer-I
Semester	: V	Course Time	: July-Nov 2011

Required Text Books:

1. Warren L. Mccabe, Julian C. Smith and peter Harriott, Unit Operations of Chemical Engineering, 6th Edn., McGraw Hill International Edition, New York 2001.
2. Robert E. Treybal, Mass-Transfer Operations, 3rd Edn., McGraw Hill International Edition, Singapore, 1980.
3. Coulson J.M., J.F. Richardson, J.R. Backhurst and J.M. Harker, Coulson & Richardson's Chemical Engineering, Vol. I, 6th Edn., Butter worth Heinemann, Oxford, 1999.

Objectives:

To familiarize:

1. Diffusion phenomena of mass transfer operations.
2. Various mass transfer theories.
3. Humidification operations.
4. Drying operation.
5. Absorption operation.

Assessment Details:

Cycle test I	: 10marks
Surprise Test	: 5marks
Cycle Test II	: 10marks
Model Exam	: 20marks
Attendance	: 5 marks

Outcomes

Students who have successfully completed this course will have full understanding of the following concepts

Course Outcome	Program Outcome
This course helps the students • To develop familiarity with major chemical process separations units. • To apply appropriate criteria for selecting among alternative separation • Technologies. • To complete design calculations for equilibrium staged separation processes (e.g., distillation, absorption). • To Complete design calculations for differential contactors. • To apply mass transfer fundamentals to calculate rates of mass transfer for practical situations and to identify rate-limiting processes. • To develop a good understanding of the physical principles underlying mass transfer. • To understand the methodology and quantitative approach of the process • Engineer and to be able to use this approach in problem solving.	• An ability to apply knowledge of math, science and engineering • An ability to identify, formulate and solve engineering problems • An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice • Gain knowledge on theoretical and practical aspects of separation processes. • Gain knowledge on the basic mass transfer concepts. • Gain knowledge of the basic design parameters. • Solve simple diffusion problems • Formulate mass transfer problems in terms of film and overall mass transfer coefficients • Solve problems for gas absorption in packed columns • Analyze the performance of wetted-wall columns, packed towers, Plate columns, humidification and drying equipment

Detailed Session plan:

DIFFUSION
Molecular diffusion, steady state molecular diffusion in fluids at rest and in laminar flow, molecular diffusion in gases-steady state diffusion: of A through nondiffusing B, equimolal

counter diffusion, in multicomponent mixtures. Molecular diffusion in liquids-steady state diffusion: of A through nondiffusing B, equimolal counter diffusion. Effect of temperature and pressure on diffusivity.					
Session No.	Topics to be covered	Time (min)	Ref	Teaching method	Testing method
1	Introduction ,Molecular diffusion	50	1,2	BB	Discussion
2	Steady state molecular diffusion in fluids at rest and in laminar flow	50	2	BB	Discussion
3	Molecular diffusion in gases-steady state diffusion: of A through nondiffusing B	50	2	BB	Assignment
4	Molecular diffusion in gases-steady state diffusion: equimolal counter diffusion	50	2	BB	Assignment
5	Molecular diffusion in gases-steady state diffusion: in multicomponent mixtures	50	2	BB	Assignment
6	Molecular diffusion in liquids-steady state diffusion: of A through nondiffusing B	50	2	BB	Assignment
7	Molecular diffusion in liquids-steady state diffusion: of A through nondiffusing B	50	2	BB	Assignment
8	Molecular diffusion in liquids-steady state diffusion: equimolal counter diffusion	50	2	BB	Assignment
9	Effect of temperature and pressure on diffusivity	50	2	BB	Group Discussion
INTERPHASE MASS TRANSFER AND COEFFICIENTS Mass transfer coefficients, film theory, penetration theory, surface-renewal theories. Mass-, Heat-, and momentum-transfer analogies, interphase mass transfer- equilibrium, diffusion between phases: local two-phase mass transfer, local overall mass-transfer coefficients. Tray towers vs. packed towers.					
10	Introduction, Mass transfer coefficients	50	1,2	BB	Group Discussion

11	Film theory	50	2	BB	Group Discussion
12	Penetration theory	50	2	BB	Group Discussion
13	Surface-renewal theories	50	2	BB	Group Discussion
14	Mass-, Heat-, and momentum-transfer analogies	50	2	BB	Group Discussion, Comparative study
15	Interphase mass transfer- equilibrium	50	2	BB	Group Discussion
16	Diffusion between phases: local two-phase mass transfer	50	2	BB	Group Discussion
17	Local overall mass-transfer coefficients	50	2	BB	Group Discussion, Assignment
18	Tray towers vs. packed towers.	50	2	BB	Group Discussion, Surprise test.
HUMIDIFICATION OPERATIONS Definitions, adiabatic saturator, Humidity chart, use of humidity chart, wet-bulb temperature, theory of wet-bulb temperature, psychrometric line and Lewis relation, equations for gas-liquid contacts, air-water system, adiabatic humidification, application of HTU method, water cooling towers.					
19	Introduction, definition	50	1,2	BB	Objective type test, Group Discussion
20	Adiabatic saturator	50	1,2	BB	Group Discussion
21	Humidity chart, use of humidity chart	50	1,2	BB	Group Discussion, Assignment

22	Wet-bulb temperature, theory of wet-bulb temperature	50	1,2	BB	Group Discussion
23	Psychrometric line and Lewis relation	50	1,2	BB	Group Discussion
24	Equations for gas-liquid contacts, air-water system	50	1,2	BB	Group Discussion
25	Adiabatic humidification	50	1,2	BB	Group Discussion
26	Application of HTU method	50	1,2	BB	Group Discussion
27	Water cooling towers	50	1,2	BB	Group Discussion
DRYING Importance of drying in processes, principles of drying, equilibrium and free moisture, bound and unbound water, constant drying conditions, constant-rate period, critical moisture content and falling-rate period, porous solids and flow by capillarity, calculation of drying time under constant drying conditions. Classification of dryers, solids handling in dryers, equipments for batch and continuous drying processes: working principle of tray driers, tower driers, rotary driers, spray driers. Concept of freeze drying.					
28	Introduction, importance of drying in processes	50	1,2	BB	Group Discussion
29	Principles of drying, equilibrium and free moisture, bound and unbound water	50	1,2	BB	Group Discussion, Surprise test
30	Constant drying conditions, constant-rate period	50	1,2	BB	Group Discussion
31	Critical moisture content and falling-rate period	50	1,2	BB	Group Discussion, objective type test
32	Porous solids and flow by capillarity	50	1,2	BB	Group Discussion
33	Calculation of drying time under	50	1,2	BB	Group

	constant drying conditions				Discussion, Assignment
34	Classification of dryers, solids handling in dryers,. Concept of freeze drying	50	1,2,3	BB	Group Discussion
35	Equipments for batch and continuous drying processes: working principle of tray driers, tower driers	50	1,2,3	BB	Group Discussion, Assignment
36	Rotary driers, spray driers	50	1,2,3	BB	Group Discussion, Assignment
ABSORPTION Introduction, types of tower packings, contact between liquid and gas, pressure drop and limiting flow rates, material balances, limiting gas-liquid ratio, rate of absorption, calculation of tower height, number of transfer units, alternate forms of transfer coefficients, absorption in plate columns, absorption with chemical reaction.					
38	Introduction, types of tower packings	50	1,3	BB	Group Discussion
39	Contact between liquid and gas pressure drop and limiting flow rates	50	1	BB	Group Discussion
40	Material balances	50	1	BB	Group Discussion
41	Limiting gas-liquid ratio, rate of absorption	50	1	BB	Group Discussion
42	Calculation of tower height, number of transfer units	50	1	BB	Group Discussion, Assignment
43	Alternate forms of transfer coefficients	50	1	BB	Group Discussion, Comparative study
44	Absorption in plate columns	50	1	BB	Group Discussion
45	Absorption with chemical reaction.	50	1	BB	Group

					Discussion