GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30)

ADVANCED MASS TRANSFER

SUBJECT CODE: 2723001

SEMESTER: II

Type of course: Chemical Engineering (Major Elective –II)

Prerequisite: Mass Transfer fundamentals

Rationale: The aim of this subject is to impart comprehensive understanding to the students regarding various Mass transfer operations and its advancement which have profound significance in Industrial and Research arenas.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topic	Teaching Hrs.	Module % Weightage
1	**Multi Component Distillation** Selection of operating pressure, Equilibrium for Multi component System, Methods for Multi Component Distillation, Design of Batch Distillation for Multi component with Rectification, with constant reflux and constant over head component, Continuous distillation of multi component system, Energy Conservation in Distillation column, Advanced topics in distillation.	**14**	**26**
2	**Membrane Separation Techniques** Principles, mechanism, cross flow, membrane materials and various membrane modules used in membrane separation processes, Classification, application and advantages of membrane separation processes.Reverse Osmosis, Dialysis, Electrodialysis, prevaporization, Gas permeation, Nano filtration, Micro filtration, Ultra filtration, Nano filtration, emulision liquid membranes etc.	**09**	**16**

3	**Super heated steam Drying** Concept of SSD, principle and working ,Comparison with conventional drying, Advantages and Disadvantages.	**06**	**12**
4	**Mass transfer with chemical reactions** Diffusion reaction equations, slow reactions, fast reactions, transition from low to fast reaction, problems in practice.	**07**	**13**
6	**Diffusion through solids** Fick's law of diffusion, Unsteady state diffusion, Type of diffusion	**03**	**05**
7	**Advances in Absorption** Criteria for selection of packed tower, tray tower, Spray chamber, Venturi Scrubber etc. Design of Falling Film Absorption, Design of Spray Chamber , Design of Venturi Scrubber, Advantage of Falling Film Absorber	**06**	**12**
8	**Degree of Freedom for Different Equipments** Specification of design variables for elements, units and complex systems, Variables specification for typical design cases, Concept of synthesis of separation sequences.	**09**	**16**

Reference Books:

1. Equilibrium-stage separation operation in chemical engineering by Ernest J. Henley and J.D. Seader.
2. Chemical Engineering Handbook 7th edition by R.H.Perry & Green D.
3. Mass Transfer Operation 3rd Edition by R.E.Treybal.
4. Sherwood, T. K., Pigford, R.L. & Wilke, C. R., Mass Transfer, McGraw Hill, Chemical Engineering Series, 1975.

Course Outcome:

After learning the course, the students should be able to analyze and understand various Mass Transfer operations and also solve various technical issues related to the advanced separation processes and their design.

List of Experiments:

- Study of membrane modules and their parts for pressure activated Membrane separation Process such as Reverse Osmosis, Nano Filtration, Ultra Filtration, Micro Filtration
- Practical on Gas Absorption
- Practical related to Drying
- Bubble Cap Distillation Column (Continuous Distillation)

Open Ended Project:

The practical work at masters must be largely consisting of OEP. In each case a sample set may be provided and the faculty member may be empowered to select appropriate problems for practical work. At the end of semester before submission of marks of PA and term work, the faculty member will upload the three best problems done by the students during the practical hours. The title area of project with practical problem along with the complete details and names of the students and name of the supervisor, branch and name of the college be specified so that this information can be published from GTU website.

Open Ended projects in Advanced Mass Transfer may include:

1. Preparation of different Membrane Separation modules
2. Fabrication of Gas- Liquid Absorption Equipment
3. Fabrication of Binary Distillation Unit
4. Fabrication of Multi-Component Distillation Unit
5. Calculation of degree of freedom of some complex units.

Major Equipments:

- Bubble Cap Dist Distillation Column
- Gas Absorption apparatus
- Membrane modules etc.

List of Open Source Software/learning website:

- Students can refer to video lectures available on various websites including NPTEL.
- Students can refer to the CDs which are available with some reference books for the solution of problems using softwares. Students can develop their own programs for the solutions of problems using excel, Chemcad and other simulation softwares.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website