

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CHEMICAL ENGINEERING
SUBJECT NAME: MULTI COMPONENT DISTILLATION
SUBJECT CODE: 2180505
B.E. 8th SEMESTER

Type of course: Chemical Engineering

Prerequisite: Mass Transfer operations, Process Equipment Design

Rationale: The objective of this course is to apply the principles of mass transfer operations to specific applications, separation and/or purification processes which involves multi components. The goal is to provide students with the theoretical/analytical aspects to design multi component distillation equipment and to deal with complex problems of separating multi components.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	2	0	5	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Selection of Key Component: Light and heavy key component, Split key and Adjacent key, Distribution of key and non-key components	03	06
2	Sequencing of Distillation Column: Concept, Selection criteria with industrial examples	03	06
3	Selection of Operating Pressure: Determination of operating pressure for the various industrial distillation columns, Criteria for vacuum distillation, Advantages & Disadvantages of vacuum distillation, Determination of vapor-liquid Equilibrium data	06	11
4	Methods for Finding Theoretical Stages : Short cut methods: Fenske-Underwood-Gilliland's method, Rigorous methods: Lewis-Metheson method, Theile-Geddes method, Equation tearing procedures using tridiagonal matrix algorithm	14	26
5	Azeotropic and Extractive Distillation: Concept and Working principle, Industrial examples, Determination of number of theoretical stages for azeotropic and extractive distillation, advantage and disadvantage over each other.	06	11
6	Tower Diameter and Pressure Drop: Criteria of selection between tray tower and packed tower, Various type of packings, Selection of tray type, Determination of tower diameter and pressure	07	13

	drop, Tray Efficiency and HETP.		
7	Multicomponent Batch Distillation: Design of multicomponent batch distillation with and without rectification.	07	13
8	Energy Saving in Distillation : Optimum design of system, Use of high efficiency trays, Heat integration, Advanced process control, Thermally coupled distillation column, Use of heat pumps, Efficient operation of distillation column, Replace the distillation partially or completely with New separation techniques	08	14

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	21	21	7	14	

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Introduction to Process Engineering & Design by S.B.Thakore & B.I. Bhatt. Tata McGraw-Hill, 2007.
2. Distillation dynamics and control by P.B. Deshpande, Arnold USA 1985.
3. Perry's chemical engineers handbook, 7th edition, McGraw-Hill, USA, 2000.
4. Distillation design by H.Z.Kister, , McGraw-Hill, USA,1992.
5. Equilibrium-stage separation operation in chemical engineering by Ernest J. Henley and J.D. Seader.
6. Coulson and Richardson's Chemical Engineering Volume 6 (Design), 2nd Edition, by R.K. Sinnott, Pergamon Press, Oxford, UK (1993).

Course Outcome:

After learning the course the students should be able to:

- Select key component
- Calculate number of theoretical and actual stages required for multi component distillation by using various methods.
- Understand how to break azeotrope using azeotropic and extractive distillation.
- Determine reflux ratio required for the distillation operation.
- Calculate tower diameter and operating pressure for multi distillation column.
- Understand various design options for energy conservation in distillation column.

List of Tutorials:

Students can identify problems related to its design and application in current industries. Students can modify the design or can suggest the changes required for better operation in terms of economy and efficiency. Students can also optimize the equipment for better results and data collection. Students need to prepare a report on the same topic and also to prepare power point presentation on the same.

List of Open Source Software/learning website:

- ✓ Students can refer to video lectures available on the websites including NPTEL lecture series.
- ✓ Students can refer to the CDs available with some reference books for the solution of problems using software's/spreadsheets. Students can develop their own programs/spreadsheets for the solution of problems.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.