GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL TECHNOLOGY (36)
MECHANICAL OPERATIONS IN CHEMICAL PROCESS INDUSTRIES
SUBJECT CODE: 2143608
B.E. 4th SEMESTER

Type of Course: Chemical Technology

Prerequisite: Basic knowledge of material and energy balance

Rationale: The objective of this course is to study various mechanical operations used in chemical industries involving solid-liquid handling and separation

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Particulate Techniques - Solids and its flow properties:** Definitions of the mean diameters of the solid particles, Characterization of solid particles, Mixed particles sizes and analysis, Screen analysis, properties of particulate masses, cumulative and differential analysis.	06	15
2	**Size Reduction, Enlargement & Screening:** Principles of comminution, Rittinger's and kick's laws, Bond's crushing law and work index, Size reduction equipment, crushers, grinders, Ultra-fine grinders, Cutting machines, Open circuit and closed circuit operation, Different screening equipment, Comparison of ideal and actual screens, Screen effectiveness.	10	25
3	**Filtration and Sedimentation :** Various mechanism of filtration, Cake filters- constant pressure and constant rate filtration,, Filter press, Shell and leaf filters, Rotary drum filters, Centrifugal filters, Filter media, Filter aids, Classification, Sink and float method, Differential settling methods, Clarifiers and thickeners, Batch sedimentation, Rate of sedimentation, Thickeners, sedimentation zones in continuous thickeners, Cyclones, Hydrocyclones.	10	25
4	**Mixing and Agitation:** Introduction to solid mixing, Types of mixers and their industrial application. Agitation of liquids, Purpose of Agitation, Agitation Equipment, Different types of agitators and their selection criteria, Flow patterns in agitated vessels, prevention of swirling and vortex formation.	06	15
5	**Fluidization and Conveying:** Conditions for Fluidization, Types of fluidization, Applications of fluidization, Slurry and pneumatic transport, Different conveyers for	10	20

	solid handling and transportation.		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
60	10	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. Unit Operations of Chemical Engg. By W.L. McCabe, J. C. Smith &Harriott, 6th Edition Mc-Graw Hill international.
2. Introduction to Chemical Engineering by W. L. Badger & J.T. Banchero.
3. "Chemical Engineering", Volume-2, 4th edition by Coulson & Richardson.
4. Unit Operation by Brown & Associates.
5. Principles Of Unit Operations, 2nd Edition, By Alan S. Foust, Leonard A. Wenzel, Curtis W. Wiley-India Publishers.
6. Perry's Chemical Engineers handbook, 7th edition by Perry & Green, Mc-Graw Hill International

Course Outcomes:

1. To understand different properties of particulate solids and decide how to carry out its analysis.
2. To express criteria for selection of specific size reduction equipment based on their final applications in various chemical industries like dyes and pigments, pharmaceuticals etc.
3. To be able to utilize theoretical knowledge for fundamental design of suitable solid liquid separation operation.
4. To build a bridge between theoretical and practical concept used in industry

List of Experiments:

1. Sieve analysis – 1
2. Sieve analysis – 2
3. Sieve Analysis
4. Jaw Crusher
5. Roll Crusher
6. Sigma Mixer
7. Cyclone Separator
8. Sedimentation
9. Filtration
10. Centrifuge

Open Ended Project fields:-

Students are free to select any area of science and technology based on chemical technology applications to define Projects.

Some suggested projects are listed below:

- Study on effects of different parameters for separation of solid from air by laboratory scale cyclone separator.

- Study on mixing characteristics of different solids.
- Laboratory Scale Batch Centrifuge for solid liquid separation.

Major Equipment:

- Sieve shaker, Jaw Crusher, Roll Crusher, Ball Mill, Sigma Mixer and Cyclone Separator.

List of Open Source Software/learning website:

1) www.solidliquidseperation.com
2) www.filtrationandseperation.com
3) Delnet

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.