

Subject Code: 01CH1303
Subject Name: Mechanical Operations
B.Tech. Year – II (Semester III)

Objective: The course is aimed to learn about characterization of solids, size reduction, techniques of solid –fluid separation and mixing.

Credits Earned: 04 credits

Course Outcomes: After completion of this course, student will be able to:

1. Understand the fundamental design principles of unit operations used in mechanical operation
2. Analyze the performance of size reduction equipment
3. Utilize the technological methods related to unit operations in process plant
4. Calculate the power consumption required for size reduction and agitation.

Pre-requisite of course: None

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA	CSE	Viva (V)	Term Work (TW)	
3	0	2	4	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	Introduction to Particulate Solids Particle Shape, Size, Mixed Particle Size and Size Analysis: Cumulative and Differential Analysis: Mean Diameters, Screen Analysis: Standard Screens, Types of Industrial Screens: Stationary Screens, grizzly, gyratory screens, vibrating screens, comparison of ideal and actual screens, material balances over screen, Screen Effectiveness, Capacity.	7
2	Size Reduction Operations Empirical Laws: Rittinger & Kick law. Bond's law and work index. Fundamentals of comminution, energy need in comminution, crushing efficiency, Classifying size reduction equipment. Crusher: jaw crusher, gyratory crusher. Grinders: impactors & Hammer Mill, Ball Mills. Ultrafine grinders. Open-circuit and closed circuit operation.	8



3	Hydro-Mechanical Separation Gravity based Settling processes, gravity classifier, sorting classifier, method of differential settling. Flocculation, Clarifier & thickener, batch sedimentation, Sedimentation Rate, Sedimentation Zones, Sedimentation Equipment: Clarifier, Thickeners, Cyclones.	8
4	Filtration Phenomenon of Filtration, filter-medium resistance, constant pressure filtration, continuous filtration, constant rate filtration, Cake filter, discontinuous pressure filter: principle, working, continuous vacuum filter: principle, working of drum filter, centrifugal filters: principle, working, filter media, filter aids, principles of cake filtration, pressure drop across filter medium and cake.	8
5	Agitation & Mixing Fundamental concept of agitation, agitation equipment, flow patterns in agitated vessel, swirling, draft tubes. Power consumption of agitated vessel, power correlation, Blending & Mixing: blending of miscible liquids, blending in process vessels, blending process in storage tanks, jet mixers.	7
	Total	38

List of Experiments

1. To perform the sieve analysis of a given sample of solid particles by sieve shaker
2. To carry out Batch Sedimentation Tests.
3. To study the effect of froth flotation in the recovery of given sample from the solution.
4. To study the operation of Jaw Crusher.
5. To determine Critical Index, Work Index, Bond's Law, Rittinger's Law & Kick's Law for Ball Mill.
6. To calculate the overall efficiency of the cyclone separator.
7. To Study the power consumption in an agitator.
8. To study the different types of Filter Press.

Reference Books:

1. "Unit operations of chemical engineering", McCabe, W. L., Smith, J. C., & Harriott, P., (Vol. 7), New York: McGraw-hill, 2014.
2. "Chemical Engineering", Coulson and Richardson Vol. 2. Butterworth Heinemann Publications, 2002.
3. "Mechanical Operations for Chemical engineers", Narayanan C.M. & Bhattacharya B.C. Khanna Publishers. 3rd Ed., 1999.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20	30	25	10	15	-

Instructional Method:

- a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by white board, may also use any of tools such as collaborative learning, demonstration, role play, Quiz, brainstorming, MOOCs, Active Learning Assignments etc.
- b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Web Resources:

- a. <https://nptel.ac.in/courses/103106158>
- b. <https://nptel.ac.in/courses/103107123>