

Subject Code: 01CH0203

Subject Name: Mechanical Operations

B.Tech. Year - II

Objective: To study and understand the basic mechanical operations (like Crushing, Grinding etc.) taking place in a chemical industry and the laws governing such operations.

Credits Earned: 5 Credits

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

1. To build basic knowledge of various mechanical operations.
2. To review the practical importance and relevance of unit operations used for crushing, grinding and size separation in chemical industry.
3. To utilize the technological methods related to unit operations in process plant.
4. To study a detailed overview of equipment used to perform various mechanical operations and problems associated during the implementation and applications.
5. To understand how solids and liquids are subjected to various physical forces to effect separation, size reduction.

Pre-requisite of course: Basic concepts of Fluid Mechanics & Elementary Physics

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	CSE	Internal (I)	Viva (V)	Term work (TW)	
4	0	2	5	50	20	30	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.	8
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.	10
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 Equipments: Clarifier, Thickeners, Cyclones, decanters.	10
4	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 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.	10
	Total Hours	46

References:

1. McCabe Smith, "Unit Operation in Chemical Engineering" 5th ed. McGraw Hill (1985).
2. Coulson and Richardson: Chemical Engineering, Vol. 2. Butterworth Heinemann Publications.
3. Narayanan C.M. & Bhattacharya B.C. "Mechanical Operations for Chemical engineers", Khanna Publishers. 3 rd 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
25%	35%	20%	15%	5%	-

List of Experiments:

1. To carry out Batch Sedimentation Tests.
2. To study the effect of Froth Flotation in the recovery of given sample from the solution.
3. To calculate the overall efficiency of the cyclone separator.
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 determine Screen Efficiency for the given sample.
7. To study Filter Press.

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 black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs 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.
- d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Online Web Resources:

1. <http://nptel.ac.in/courses/103107123/>
2. <https://ocw.mit.edu/courses/audio-video-courses/#chemical-engineering>
3. <https://www.youtube.com/watch?v=GO8HkEZlb9k>