

COURSE TITLE	MECHANICAL OPERATIONS
COURSE CODE	01CH1303
COURSE CREDITS	4

Objective:

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

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

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

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

Contents : Unit	Topics	Contact Hours
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 Hours		38

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiment 1 To perform the sieve analysis of a given sample of solid particles by sieve shaker	2
2	Experiment 2 To carry out Batch Sedimentation Tests.	2
3	Experiment 3 To study the effect of froth flotation in the recovery of given sample from the solution.	2
4	Experiment 4 To study the operation of Jaw Crusher.	2
5	Experiment 5 To determine Critical Index, Work Index, Bond's Law, Rittinger's Law & Kick's Law for Ball Mill.	2
6	Experiment 6 To calculate the overall efficiency of the cyclone separator.	2
7	Experiment 7 To Study the power consumption in an agitator.	2
8	Experiment 8 To study the different types of Filter Press.	2
Total Hours		16

Textbook :

- 1 Mechanical Operations (Unit Operations) of Chemical Engineering, A.P.Kulkarni and R.S.Hiremath, Everest Publishing House, 2023
- 2 “Mechanical Operations for Chemical engineers”, 3rd Ed. , Narayanan C.M. & Bhattacharya B.C., Khanna Publishers, 1999

References:

- 1 “Unit operations of chemical engineering”, (Vol. 7), , “Unit operations of chemical engineering”, (Vol. 7), , McCabe, W. L., Smith, J. C., & Harriott, P., McGraw-hill ,New York, 2014
- 2 .“Chemical Engineering”, Vol. 2. , “Chemical Engineering”, Vol. 2. , Coulson and Richardson, Butterworth Heinemann Publications,, 2002

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					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
20.00	30.00	25.00	15.00	10.00	0.00

Instructional Method:

- 1 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.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

- 1 <http://nptel.ac.in/courses/112105171/>
- 2 <http://www.msubbu.in/ln/fm/>
- 3 http://www.engineeringtoolbox.com/fluid-mechanics-t_21.html