

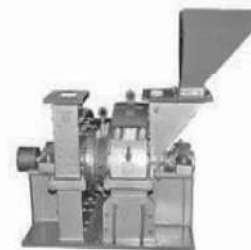
# 19CH202 MECHANICAL UNIT OPERATIONS

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P	WA/RA	SSH/HS	CS	SA	S	BS
45	-	30	25	50	-	-	5	5



Source:

<https://www.indiamart.com/singhasini/size-reduction-equipments.html>

## COURSE DESCRIPTION AND OBJECTIVES:

This course provides knowledge in the basics of unit operations employed in chemical process industries. The objective of this course is to familiarize student on the principles and practices involved in transporting, separating and storing of solids and associated unit operations.

## COURSE OUTCOMES :

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Apply the basic methods of characterization to determine the properties of solid particles.	1
2	Formulate the solution for complex unit operations by using the principles of engineering mathematics.	2
3	Design of various unit operation devices to meet the desired specifications.	3
4	Investigate the problems encountered during working of equipments related to unit operations.	4
5	Conduct experiments of various unit operations for a given industry problem using modern tools.	5

## SKILLS:

- ✓ Perform cumulative and differential particle size analysis.
- ✓ Identify the suitable mixer required for mixing cohesive and non cohesive solids.
- ✓ Recognize the required specifications of the size reduction equipment for a given feed.
- ✓ Identify the filtration equipment required for a specific application.
- ✓ Compare the efficiency of separation equipment.

**UNIT-I** **L-9**

**PROPERTIES AND CHARACTERIZATION OF SOLIDS** : Properties of particulate masses; Characterization of solid particles- particle shape, particle size, mixed particle size and size analysis; Screen analysis; Standard screen series; Pressures in masses of particles; Storage of solids; Pressures in bins and silos; Flow out of bins.

**UNIT-II** **L-9**

**MIXING OF SOLIDS** : Mixing of solids; Types of mixers; Mixers for cohesive solids; Criteria of mixing; Effectiveness; Mixers for free flowing solids; Mixing index- mixing index for blending granular solids, mixing index at zero time; Rate of mixing.

**CONVEYING OF SOLIDS** : Belt conveyor; Screw conveyor; Pneumatic conveyor; Bucket elevator; Hydraulic conveying.

**UNIT-III** **L-9**

**PRINCIPLES OF COMMINUTION** : Criteria for comminution; Characteristics of comminuted products; Energy and power requirements in comminution; Empirical relationships; Size reduction equipment- crushers, grinders, ultrafine grinders, cutting machines.

**PARTICLE SIZE ANALYSIS** : Screening; Screening equipment; Screen effectiveness.

**UNIT-IV** **L-9**

**FILTRATION** : Introduction to filtration; Types of filters- pressure filters, vacuum filters, centrifugal filters, filter media, filter aids; Principles of cake filtration; Pressure drop through filter cake; Continuous filtration; Numericals on filtration.

**UNIT-V** **L-9**

**PARTICLE SEPARATION TECHNIQUES** : Separations based on motion of particles through fluids; Gravity settling processes- gravity classifiers, sorting classifiers, clarifiers and thickeners, flocculation, batch sedimentation, clarifier and thickener design; Centrifugal settling processes; Electrostatic precipitators; Cyclones and hydroclones; Crystalization- introduction, crystal geometry, nucleation, origin of crystals in crystallizers.

**LABORATORY EXPERIMENTS****LIST OF EXPERIMENTS****TOTAL HOURS: 30**

1. Determination of particle size using screen analysis.
2. Determination of the effectiveness of a screen.
3. Verification of size reduction laws using jaw crusher.
4. Verification of size reduction laws using ball mill.
5. Verification of size reduction laws and finding efficiency using roll crusher.
6. Determination of compressibility coefficient using sedimentation process.
7. Determination of filter medium resistance and cake resistance using plate and frame filter press.
8. Determination of percent recovery of coal from coal-sand mixture using froth flotation cell.
9. Determination of the dehusking efficiency of rubber roll sheller.
10. Determination of the collection efficiency of a cyclone separator.
11. Determination of the size using ICI sedimentation.
12. Determination of the rate of filtration in a leaf filter.
13. Determination of size reduction ratio and power consumption in Hammer mill.
14. Determination of filter medium resistance and cake resistance using Rotary vacuum filter.

**TEXT BOOKS:**

1. McCabe, W. L., Smith J. C. and Peter Harriot, "Unit Operations of Chemical Engineering", 7<sup>th</sup> edition, McGraw-Hill, 2005.
2. Foust A. S., Wenzel L. A., Clump C. W., Maus L. and Anderson L. B., "Principles of Unit Operations", 2<sup>nd</sup> edition, Wiley, New York, 2004.

**REFERENCE BOOK:**

1. Perry R. H. and Green D. W., "Chemical Engineer's Hand book", 8<sup>th</sup> edition, McGraw-Hill, New York, 2007.