

<b>4<sup>th</sup>Semester</b>	<b>RPP4D001</b>	<b>Mechanical Operations</b>	<b>L-T-P 3-0-0</b>	<b>3 CREDITS</b>
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**Course Objectives:** The objective of this course is to develop the understanding of the students about solids, their characterization, handling and the various processes involving solids. The students are exposed to basic theory, calculations and machinery involved in various solid handling operations.

**Module I: (10 hrs)**

**Characterization and Handling of Solids:**

Characterization of solid particles, Shape, size, specific surface, Particle size distribution Properties of particulate masses, Major distinctive properties, pressures in masses of particles, angle of internal friction, angle of repose. Conveying of bulk solids, Basic idea of conveyor, conveyor selection, screw, belt, vibrating, continuous flow and pneumatic conveyors. Storage and weighing: bulk storage, bin storage, feeders (vibrating hopper, screw feeder, belt feeder), batch and continuous weighing.

**Module II: (10 hrs)**

**Screening:** Capacity and Effectiveness of a screen, calculation of average size of particles in mixture by screen analysis, types of screens.

**Agitation and Mixing:** Agitation of low viscosity particle suspensions, axial flow impellers, radial flow impellers, close-clearance stirrer, unbaffled tanks, baffled tanks, basic idea for designing agitators. Power number, Froude number, power consumption in agitation

**Mixing of Solids:** Types of mixers, various mixers for cohesive solids, power requirements, mixing index, axial mixing. Mixers for free flowing solids, ribbon blenders, screw mixers, tumbling mixers import wheels, mixing index in blending granular solids, mixing index at zero time, rate of mixing.

**Module III: (10 hrs)**

**Size Reduction:** Principles of Comminution, Criteria for comminution, characteristics of products, Energy and Power requirements, Bond's, Rittinger's and Kick's Law and Work Index.

**Size Reduction Equipment:** Crushers, Grinders, and ultrafine grinders cutting machines, equipment operation.

**Filtration:** Classification of filters, various types of cake filters, principles of cake filtration,

**Clarifying Filters:** Liquid clarification, Gas cleaning, principles of clarification.

Filtration Equipment and centrifuges and their selection, Cross flow Filtration, micro filtration.

**Module IV: (08 hrs)**

**Settling:** Motion of particles through fluids: Terminal velocity, hindered settling, Stoke's law,

**Gravity Settling Processes:** Classifiers, clarifiers, thickeners, flocculation, rate of sedimentation Centrifugal Settling processes: Cyclones, hydroclones, decanters, tubular, disk and nozzle discharge centrifugal sludge separators, Centrifugal class fitters, principles of centrifugal sedimentation.

**Module V:**           **(07 hrs)**

**Fluidization:** Fluidization and fluidized bed, conditions for fluidization, Ergun equation and Kozeny-Carman equation, minimum fluidization velocity, types of fluidization, expansion of fluidized beds and particulate fluidization, continuous fluidization; industrial applications.

**Books:**

- McCabe, Warren L., Julian C. Smith and P. Harriot, Unit Operations of Chemical Engg., 7th Edn., McGraw Hill, 2005.
- A.S. Foust, L.A. Wenzel, C.W. Clump, L. Maus, L.B. Anderson, 'Principles of Unit Operations', 2nd Edn., John Wiley & Sons, 2008.
- J.H. Harker, J.F. Richardson, J.R. Backhurst, 'Chemical Engg.', Vol, 2, 5th Edn., Butterworth-Heinemann, 2003.
- W.L. Badger and J.T. Banchero, 'Introduction to Chemical Engg.', McGraw Hill.
- R.H. Perry, D.W. Green, 'Chemical Engineers Handbook', 8th Edn., McGraw Hill, 2008.