

LOK JAGRUTI UNIVERSITY (LJU)
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Chemical Engineering (708)
Bachelor of Engineering (B.E.) - Semester – V

Course Code:	017083502
Course Name:	Mechanical Operation
Category of Course:	Professional Core Course (PCC)
Prerequisite Course:	Pollution Control, Safety and Health Management

Teaching Scheme				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Total Hours
4	0	2	5	40

Syllabus				
Unit No.	Topic/	Prerequisite Topic	Successive Topic	Teaching Hours
01	Introduction to Mechanical Operation			1 (4%)
	1.1 Concept of Unit Operation and Unit Process	---		
	1.2 Importance of Mechanical Operation in Chemical Industry	---	---	
	1.3 Application of Mechanical Operation	---		
02	Solid and its Flow Properties			4 (10%)
	2.1 Characteristics of Solid Particles (Particle shape)	---		
	2.2 Properties of Particulate Masses (Bulk storage, Bin storage)	---		
	2.3 Particle Size and Mixed Particle Size Analysis and Average Particle Size	---	---	
	2.4 Specific Surface Area of Mixture and Number of Particle in a Mixture	---		
2.5 Screen Analysis (Types of screen analysis, Standard screen series)	---			
03	Size Reduction and Enlargement			5 (12%)
	3.1 Principle of Comminution	---		
	3.2 Size Reduction Laws (Kick's law, Rittinger's law, Bond's law, Work Index)	---		
	3.3 Size Reduction Equipment: Crushers, Grinders and Ultrafine Grinders (Jaw crusher, Gyratory crusher, Roll crusher, Hammer mill, Ball mill, Fluid energy mill)	---	---	
3.4 Open Circuit and Close Circuit Operation	---			
04	Screening			3 (8%)
	4.1 Capacity and Effectiveness of Screen	---		
	4.2 Comparison of Ideal and Actual Screen	---		
	4.3 Screen Effectiveness	---	---	
4.4 Screening Equipment: Grizzly, Trommels, Oscillating Screen and Vibrating Screen	---			
05	Mixing and Agitation			3 (8%)
	5.1 Different Types of Agitators and Their Selection Criteria	---		
	5.2 Types of Impellers	---		
	5.3 Flow Pattern in an Agitated Tank	---	---	
	5.4 Calculation of Power Required for Agitation	---		
5.5 Prevention of Swirling in an Agitated Tank	---			
06	Equipment for Mixing			3 (8%)
	6.1 Types of Mixers	---		
	6.2 Mixers for Cohesive Solids (Change-can & Banbury mixer, Two arm kneader)	---	---	
6.3 Mixers for Non-Cohesive Solids (Ribbon blender, Tumbling mixer)	---			
07	Filtration			6 (14%)
	7.1 Cake Filter and Clarifying Filter	---		
	7.2 Filter Media and Filter Aid	Fabric filters (017083404 – Unit 4.1)	---	
	7.3 Filter Press, Shell and Leaf Filter	---		
7.4 Rotary Drum Filter, Centrifugal Filter	---			
08	Sedimentation			5 (12%)
	8.1 Batch Sedimentation and Rate of Sedimentation	Sedimentation (017083404 – Unit 6.2)		
	8.2 Gravity Classifier	Gravity settling chamber (017083404 – Unit 4.1)	---	
	8.3 Clarifier and Thickeners (Gravity thickener, Clarifying filter)	---		
	8.4 Differential Settling Method and Sink and Float method	---		
8.5 Cyclones and Hydro cyclones	Cyclone separator (017083404 – Unit 4.1)			
09	Fluidization and its Application			5 (12%)
	9.1 Conditions for Fluidization	---		
	9.2 Types of Fluidization (Particulate and aggregative fluidization)	---	---	
	9.3 Minimum Fluidization Velocity	---		
9.4 Application of Fluidization	---			

Concept of Conveying				5 (12%)
10	10.1 Concept of Conveying	---	---	
	10.2 Slurry and Pneumatic Transport	---		
	10.3 Mechanical and Pneumatic Conveying	---		
	10.4 Elevators and Different Types of Conveyors (Belt, Screw, Apron, Bucket Elevator)	---		

Sr No.	Practical Title	Link to Theory Syllabus
1	To determine the screen efficiency for the given sample by Sieve analysis.	Unit 2
2	To determine Rittinger's constant, Bond's constant, Kick's constant, Work Index as well as Theoretical & Actual Capacity using Roll crusher.	Unit 3
3	To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index using Jaw Crusher.	Unit 3
4	To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index using Ball mill.	Unit 3
5	To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index using Hammer mill.	Unit 3
6	To determine the screen efficiency for the given sample by vibrating screen.	Unit 4
7	To calculate the overall efficiency of the Cyclone separator.	Unit 8

Major Components/ Equipment	
Sr. No.	Component/Equipment
1	Vibrating Screen
2	Sieve Shaker
3	Roll Crusher
4	Jaw Crusher
5	Hammer Mill
6	Ball Mill
7	Cyclone Separator

Proposed Theory + Practical Evaluation Scheme by Academicians (% Weightage Category Wise and it's Marks Distribution)						
L:	4	T:	0	P:	2	
Note: In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject. Each Test will be of 25 Marks. Each Test Syllabus Weightage: Range should be 20% - 30%						
Group (Theory or Practical)	Group (Theory or Practical) Credit	Total Subject Credit	Category	% Weightage	Marks Weightage	
Theory	4	5	MCQ	47%	57	
Theory			Theory Descriptive	27%	33	
Theory			Formulas and Derivation	0%	0	
Theory			Numerical	8%	10	
Expected Theory %	83%			Calculated Theory %	83%	100
Practical	1		Individual Project	0%	0	
Practical			Group Project	0%	0	
Practical			Internal Practical Evaluation (IPE)	8%	50	
Practical			Viva	0%	0	
Practical			Seminar	8%	50	
Expected Practical %	16%		Calculated Practical %	16%	100	
Overall %	99%			99%	200	

Course Outcome

	<i>Upon completion of the course students will be able to</i>
1	To undertake particle characterization and implement size reduction techniques, alongside conducting particle size analysis, to align with the requirements of chemical industries and to evaluate the practical significance and applicability of unit operations involved in crushing, grinding, and size separation.
2	To understand various methodologies for mixing, agitation and estimating the requisite power input.
3	To assess the operational parameters of diverse filtration apparatus and sedimentation processes.
4	To comprehend the dynamics of fluid flow within a fluidized bed system and conveying of solids.

Suggested Reference Books

1	“Unit Operation in Chemical Engineering”, McCabe Smith, McGraw Hill (1985), 7th ed.
2	“Unit Operation in Chemical Engineering”, McCabe Smith, McGraw Hill (1985), 5th ed.
3	“Chemical Engineering”, Coulson and Richardson: Butterworth Heinemann Pub, Vol. 2.
4	“Introduction to Chemical Engineering”, Badger and Bencharo, Tata McGraw hill.
5	“Principles of Unit Operations” Foust A. S. & associates, John Wiley and Sons (1980).

List of Open Source Software/Learning Website

1	https://nptel.ac.in/courses/103/107/103107123/
2	https://onlinecourses.nptel.ac.in/noc19_ch32/preview
3	https://nptel.ac.in/courses/103/107/103107127/