GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3153516
Semester –V
Subject Name: Basics of Mechanical Operations

Type of course: Open Elective

Prerequisite: A good understanding regarding basic operations used for size reduction of materials. Mathematical background is also essential in this respect.

Rationale: The main objective of this subject is to study the basic mechanical operation (crushing, grinding, screening, filtration, etc.) takes place during the process in chemical industry. It also provides platform to study and analyze various properties associated with the solid when it is in flow condition. This subject provides the fundamental knowledge regarding to particle size reduction and enlargement by various methods and also deals with the detail construction & working of equipment's used for mechanical operations.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Solids and Its Flow Properties:** Characterization of solid particles, Mixed particles sizes and analysis, Screen analysis, properties of particulate masses, Mixing of solids, Mixer for cohesive solids, Mixer for free flowing solids.	06
2	**Size Reduction, Enlargement, Screening:** Principles of comminution, Rittinger's and kick's laws, Bond's crushing law and work index, Size reduction equipments, crushers, grinders, Ultra fine grinders, Cutting machines, Open circuit and closed circuit operation, Screening equipment, Comparison of ideal and actual screens, Screen effectiveness	10
3	**Fluidization and Conveying:** Conditions for Fluidization, Types of fluidization, Applications of fluidization, Slurry and pneumatic transport, Conveyers. **Mixing and Agitation:** Different types of agitators and their selection criteria, Calculation of power required for agitation, Scale up of agitated vessel, Static mixers	06
4	**Filtration and Sedimentation :** Introduction, Cake filters, Filter press, Shell and leaf filters, Discontinuous vacuum filters, Continuous vacuum filters, Centrifugal filters, Filter media, Filter aids, Principles of cake filtration, Clarifying filters, Gravity classifiers, Sink and float method, Differential settling methods, Clarifiers and thickeners, Batch sedimentation, Rate of sedimentation, Thickeners, sedimentation zones in continuous thickeners, Cyclones, Hydrocyclones, Cenrifuges.	14

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3153516

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**15**	**15**	**10**	**8**	**7**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Foust A. S. & associates, "Principles of Unit Operations" John Wiley and Sons (1980).
2. McCabe Smith, "Unit Operation in Chemical Engineering" 5th ed. McGraw Hill (1985).
3. Perry R.H. & Chilton C.H., "Chemical Engineers Hand Book", 7th ed. McGraw hill.
4. Badger and Bencharo, "Introduction to Chemical Engineering". Tata McGraw hill.
5. S. K. Gupta, "Momentum Transfer Operation". Tata McGraw Hill (1979)
6. Davidson J.F. &Harrison D."Fluidization" Academic press (1985)
7. Kunni & Levenspiel "Fluidization engineering "Wiley (1962) 8. Brown, G.G. and associates "Unit operations" Wiley, New York, (1950).
8. Coulson and Richardson: Chemical Engineering, Vol. 2.Butterworth Heinemann Pub
9. Welty, Wicks, Wilson & Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th ed. Wiley Narayanan C.M.& Bhattacharya B.C. "Mechanical Operations for Chemical engineers", Khanna Publishers. 3 rd Ed.1999

Course Outcomes:

After undergoing this course the students will be able to

Sr. No.	CO statement
CO-1	To build basic knowledge of various mechanical operations.
CO-2	To review the practical importance and relevance of unit operations used for crushing, grinding and size separation in chemical industry.
CO-3	To utilize the technological methods related to unit operations in process plant.
CO-4	To study a detailed overview of equipment used to perform various mechanical operations and problems associated during the implementation and applications.
CO-5	To build a bridge between theoretical and practical concept used in industry

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3153516

List of Experiments (any five):

Sr. No.	List of experiments
1.	To carry out the batch sedimentation tests.
2.	To study the effect of forth flotation in the recovery of given sample from the solution.
3	To calculate the overall efficiency of the cyclone separator.
4.	To find mixing index.
5.	To determine Critical index, Work Index, Bond's Law, Rittinger's Law and Kick's Law for Ball mill.
6.	To determine the screen efficiency for the given sample.
7.	To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index.
8.	To determine nip angle, Reduction Ratio, Ribbon Factor, Rittinger's constant, Bond's constant, Kick's constant , Work Index as well as Theoretical & Actual Capacity.
9.	To Study how the power consumption of an agitator changes with Reynolds and Froude numbers.
10.	To study the Filter Press.

List of Open Source Software/learning website:

• Reference to NPTEL lectures can be made for a better understanding regarding various unit operations.