GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3143612
Semester – IV
Subject Name: Mechanical Operations

Type of course: Professional Elective course

Prerequisite: A good understanding regarding fluid flow, material and energy balances

Rationale: This subject is intended to make students aware about various types of equipments and unit operations used for processing different feed materials.

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)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Particulate Techniques -** Solids and its flow properties: Definitions of the mean diameters of the solid particles, Characterization of solid particles, Mixed particles sizes and analysis, Screen analysis, properties of particulate masses, cumulative and differential analysis.	**03**
2	**Size Reduction, Enlargement & Screening:** Principles of comminution, Rittinger's and kick's laws, Bond's crushing law and work index, Size reduction equipment, crushers, grinders, Ultra-fine grinders, Cutting machines, Open circuit and closed circuit operation, Different screening equipment, Comparison of ideal and actual screens, Screen effectiveness.	**08**
3	**Filtration:** Various mechanism of filtration, Cake filters- constant pressure and constant rate filtration,, Filter press, Shell and leaf filters, Rotary drum filters, Centrifugal filters, Filter media, Filter aids, s.	**08**
4	**Classification & Sedimentation:** Classification, Sink and float method, Differential settling methods, Clarifiers and thickeners, Batch sedimentation, Rate of sedimentation, Thickeners, sedimentation zones in continuous thickeners, Cyclones, Hydrocyclones	**10**
5	**Centrifugal methods of separation:** Centrifugal filtration - batch, semi and continuous types of centrifuges - centrifuges for liquid-liquid and liquid-solid separation - critical speed.	**08**
6	**Gas cleaning methods, Transportation & Storage of bulk solids:** Bag filters, cyclone separation, electrostatic separation, scrubbing Storage of solids, liquids and gases. Transportation of bulk solids - different methods of transportation - type of	**08**

	conveyors and selection.	

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**15**	**15**	**10**	**10**	**5**

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. W.L.Mc.Cabe, J.C.Smith and P.Harriot, "Unit operations of chemical engineers", McGraw Hill International edition VII.
2. Badger and Banchero, "Introduction to Chemical Engineering" McGraw Hill.
3. Brown T., "Unit Operations", Asia publishing House
4. Allen T, " Particle Size Measurement" Chapman and Hall, London, 1977.
5. Foust, "Principles of Unit Operations", McGraw Hill.
6. Coulson and Richardson, "Chemical Engineering", Vol 2, Pergamon Press. **Course Outcomes:**

Sr. No.	CO statement	Marks % weightage
CO-1	To identify various terms associated with size of particles and their analysis in particulate handling operations	22
CO-2	To explain various laws relating to size reduction and understanding regarding functioning of size reduction and screening equipments.	22
CO-3	To apply particulate techniques for separation of solids from bulk of fluid through filtration.	21
CO-4	To differentiate classification and sedimentation for separation of solid phase from liquid or concentration of solids from slurry using thickeners.	14
CO-5	To describe fundamentals of centrifugal separation with various types and industrial application.	14

CO-6	To relate functioning of different equipments used fpr gas cleaning along with conveyors for solid handling and transportation	7

List of Experiments: (All ten experiments should be done)

1. Batch sedimentation test.
2. To determine critical speed, work index, Bond's constant, Rittinger's law constant, Kick's law constant for Ball mill
3. To determine screen efficiency for the given sample.
4. To verify laws of crushing.
5. To calculate efficiency of cyclone separator
6. To determine angle of nip, reduction ratio, rittinger's constant, Bond's constant, Kick's constant and work index for Roll crusher
7. To study the effect of froth flotation in recovery of sample from given solution.
8. To study filter press
9. To study experiments based on filtration
10. To study how power consumption of an agitator changes with Reynolds number and Froude number.

Major Equipments

To study utility of major Equipments like: venturi meter, orifice meter, rotameter, Notches, Pipes and fitting and Valves.

List of Open Source Software/learning website:

Reference to NPTEL lectures can be made for a better understanding regarding fluid flow under different conditions.