GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering Syllabus

Subject Code : 3164405

Subject Name : Energy Efficiencies in Mechanical Operations

WEF Academic Year :	2021 - 22
Semester :	VI
Category of the Course :	Professional Elective

Prerequisite :	Unit operations and Unit processes of Chemical Engineering, Basics of industrial equipments, Reactions involved in unit process.
Rationale :	The primary aim of this subject is to explore the fundamental mechanical operations involved in chemical industry processes, such as crushing, grinding, screening, filtration, and more. It serves as a foundation for examining and evaluating the characteristics of solids when they are in a state of motion. This course imparts essential knowledge about methods for both reducing and enlarging particle sizes, along with an in-depth exploration of the construction and functioning of equipment used in mechanical operations.

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Solids and Its Flow Properties :** Solids, Characteristics of Solid particles, Properties of particulate masses, Particle size, mixed particle size analysis, Average particle size, Specific surface area of mixture, No of particles in mixture, Screen analysis, Standard screens, Capacity and effectiveness of screen, Ideal and actual screens, Screening Equipment – Grizzly screens, Gyrating screens, Trommels, Shaking screens, Oscillating screens.	8	12
2	**Particle size reduction and size enlargement :** Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipments, crushers, grinders, disintegrators for coarse, intermediate and fine grinding,	8	16

	power requirement, work index; Advanced size reduction techniques - Nano particle fabrication - Top down approach - Bottom-up approach. Size enlargement - Importance of size enlargement, principle of granulation, briquetting, pelletisation, and flocculation. Fundamentals of particle generation.		
3	**Fluidization and Conveying :** Conditions for Fluidization, Types of fluidization, minimum fluidization velocity and pressure drop in fluidized bed, Equations for Kozeny–Carman, Burke – Plummer, Ergun, liquid – solid and gas solid systems, Applications of batch and continuous fluidization, Slurry and pneumatic transport, mechanical and pneumatic conveying, elevators, storage bins and silos for solid/liquid/gases.	12	12
4	**Filtration and Sedimentation :** Introduction, Cake filters, Filter media, Filter aids, principles of cake filtration, Filter press, Shell and leaf filters, Rotary drum vacuum filters, Centrifuges, Gravity classifiers, clarifying filter, Sink and float method, Clarifiers and thickeners, Batch sedimentation, Rate of sedimentation, Differential settling methods, sedimentation zones in continuous thickeners, Cyclones, Hydrocyclones.	10	15
5	**Mixing and Agitation :** Different types of agitators and their selection criteria, Types of Impellers, flow patterns in un-baffled and baffled tanks, Calculation of power required for agitation, Scale up of agitated vessel. Mixing of pastes/liquid/dry powder, pony mixer, ribbon blender, tumbler mixer, and static mixers.	10	16
	Total	**48**	**100**

Reference Book :

1. McCabe Smith, “Unit Operation in Chemical Engineering” 5th ed. McGraw Hill (1985).
2. Perry R.H. & Chilton C.H., “Chemical Engineers Hand Book”, 7th ed. McGraw hill.
3. Coulson and Richardson: Chemical Engineering, Vol. 2.Butterworth Heinemann Pub
4. Foust A. S. & associates, “Principles of Unit Operations” John Wiley and Sons (1980).

Course Outcome :

After Completion of the Course, Student will able to :

No.	Course Outcomes	RBT Level*
CO-1	To characterize particles and perform size reduction and size analysis of particles to meet the need of chemical industries.	20
CO-2	To review the practical importance and relevance of unit operations used for crushing, grinding and size separation in chemical industry.	20
CO-3	To evaluate the various process parameters of filtration equipments and sedimentation.	25
CO-4	To understand the fluid flow operations through fluidized bed.	20
CO-5	To identify the different types of mixing, agitation and conveying of solids and estimating the power requirement.	15

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List :

1. To determine the screen efficiency for the given sample by sieve analysis.
2. To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index using jaw Crusher.
3. To calculate the overall efficiency of the cyclone separator.
4. To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index for ball mill.
5. To determine separation efficiency by using froth flotation cell.
6. To carry out the batch sedimentation tests.
7. To carry out gravity filtration test.
8. To determine the screen efficiency for the given sample by vibrating screen.

List of Laboratory/Learning Resources Required :

Students can refer to video lectures available on the websites including NPTEL.

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