GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3150505
Semester –V
Subject Name: Particle and Fluid Particle Processing

Type of course: Professional elective course

Prerequisite: Basic knowledge of fluid mechanics and particles are required to study the course. However, the course gives insight of both fluid and particles processing in detail.

Rationale:
The main objective of this subject is to study the basic fluid particle processingto understand the basic physical unit operations in a chemical process industry. It also provides platform to study and analyze various properties associated with the solid when it is in flow condition.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination marks				Total marks
				Theory marks		Practical marks		
L	T	P	C	ESE (E)	PA (M)	PA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Solid- Fluid operations, characterization and classification	6
2	Mixing and agitation: Mixing, Agitation, Different types of agitators and their selection criteria, Calculation of power required for agitation, Scale up of agitated vessel, static mixers, intensive mixers, heating and cooling mixers.	8
3	Fluidization and Transportation: Fluid flow in porous solid beds, Conditions for Fluidization, Types of fluidization, Applications of fluidization Transportation: Mechanic, Slurry, hydraulic and pneumatic transport, conveyors	11
4	Filtration and sedimentation: Cake filters, Constant rate filtration, constant pressure filtration,Filter press, Shell and leaf filters, vacuum filters, Centrifugal filters, Filter media, Filter aids, Clarifying filters, Gravity classifiers, Sink and float method, Clarifiers and thickeners, Batch sedimentation, Rate of sedimentation, Thickeners, Cyclones, Hydrocyclones, Centrifuges.	8
5	Solid- Fluid Mass Transfer: Leaching, Crystallization, Nucleation, Growth of crystals, Drying, Solid- Fluid Reactors: Fluidized bed reactor, moving bed reactor, slurry bed reactor, fixed bed reactor.	12

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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	**20**	**15**	**10**	**10**	**0**

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. Coulson and Richardson: Chemical Engineering, Vol. 2.Butterworth Heinemann Pub
6. 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

Sr. No.	CO statement	Marks % weightage
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 understand the performance of solid-fluid reactors	20
CO-3	To understanding fluid flow through fluidized bed	20
CO-4	To evaluate the parameters of various filtration equipment and sedimentation	25
CO-5	To identify the different types of mixing, agitation and conveying of solids and estimating the power requirement	15

List of Experiments: (Minimum 08 experiments need to be performed)

1. To determine the screen efficiency for the given sample by sieve analysis
2. To determine the screen efficiency for the given sample by vibrating screen
3. 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 using roll crusher.
4. To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index using jawCrusher
5. To calculate the overall efficiency of the cyclone separator.
6. To carry out the batch sedimentation tests.
7. To carry out gravity filtration test
8. To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index for ball mill
9. To study filter press
10. To study size reduction of material by drop weight crusher
11. To determine separation efficiency by using magnetic separator
12. To determine separation efficiency by using froth flotation cell

Major Equipments

Jaw crusher, Gyratory crusher, Roll crusher, Ball mill, Cyclone separator, Plate & Frame filter press, Sieve shaker apparatus etc.

List of Open Source Software/learning website:

Reference to NPTEL lectures can be made for a better understandingregarding mechanical operation done in industriesunder different conditions.