

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CHEMICAL ENGINEERING

SUBJECT NAME: SOLID FLUID OPERATIONS

SUBJECT CODE: 2180508

B.E. 8th SEMESTER

Type of course: Chemical Engineering.

Prerequisite: Fundamental Principles of Mechanical Operations, Fluid Flow Operations and Mass Transfer Operations.

Rationale: To provide detail idea about the operations that includes solid-fluid chemical operations. It is also required to elaborate a list of the main process variables. To obtain the operation algorithm, analyse and interpret the variables behavior and problems to choose equipment for the same. Dimension the equipment and adapt methodologies for the resolution of a new situation. The general idea is to give the students an elaborate knowledge of the solid- fluid operations that are directly applicable in industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	2	0	5	70	20	10	30	0	20	150

Content:

Sr. No.	Topic	Teaching Hours	Module Weightage (%)
1	Introduction: Solid- Fluid operations, characterization and classification.	4	7
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	14
3	Fluidization: Fluid flow in porous solid beds, Conditions for Fluidization, Types of fluidization, Applications of fluidization	9	16
4	Transportation: Mechanic, Slurry, hydraulic and pneumatic transport, conveyors.	8	15
5	Filtration and sedimentation: Cake filters, Constant rate filtration, constant pressure filtration,	10	18

	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.		
6	Solid- Fluid Mass Transfer: Leaching, Crystallization, Nucleation, Growth of crystals, Drying.	8	15
7	Solid- Fluid Reactors: Fluidized bed reactor, moving bed reactor, slurry bed reactor, fixed bed reactor.	7	15

Reference Books:

1. Introduction to Chemical Engineering by W. L. Badger & J.T. Banchero.
2. "Mass transfer operation" by R. E. Treybal, Mc-Graw Hill international
3. G. G. Brown, Unit Operations, CBS Publisers & Distributors, 2005.
4. J. F. Richardson, J. H. Harker, J. R. Backhurst, Coulson and Richardson's Chemical Engineering, vol. 2, 5th ed., Butterworth, 2002.
5. C. J. Geankoplis, Transport Processes and Separation Process Principles, 4th ed., Prentice-Hall, 2003.
6. J. D. Seader, E. J. Henley, Separation Process Principles, 2nd ed., John Wiley & Sons, 2006.
7. Don W. Green, Robert H. Perry: Perry's Chemical Engineers' Handbook, eighth edition.
8. Unit Operations of Chemical Engg. By W.L. McCabe, J. C. Smith & Harriott, 6th Edition Mc-Graw Hill international.

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	15	20	5	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.

Course Outcome:

After learning the course the students should be able:

- To make students aware about all the solid fluid operations in chemical industries.
- To understand the principles behind different solid - fluid operations.
- To make student understand the global scenario and requirement of solid fluid operations and advancement in the same field.
- To understand the variety of application of solid fluid operations in chemical industries.
- To make student realize application and design related problems in solid-fluid operations in chemical industries.

List of Tutorials:

Students can select any solid- fluid mechanical operation and identify problems related to its design and application in current industries. Students can modify the design or can suggest the changes required for better operation in terms of economy and efficiency. Students can also optimize the equipment for better results and data collection. Students need to prepare a report on the same topic and also to prepare power point presentation on the same.

List of Open Source Software/learning website:

- Students can refer to video lectures available on various websites including NPTEL.
- Students can refer to the CDs which are available with some reference books for the solutions of problems using software. Students can develop their own programs for the solutions using excel, Chemical and other simulation software.

ACTIVE LEARNING ASSIGNMENTS:

Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.