GUJARAT TECHNOLOGICAL UNIVERSITY

ENVIRONMENTAL SCIENCE AND TECHNOLOGY (35)

UNIT OPERATIONS-I

SUBJECT CODE: 2143506

B.E. 4th SEMESTER

Type of course: Environmental Science & Technology

Prerequisite: Basic knowledge of unit and dimension, theoretical knowledge of mass fraction, mole fraction, material balance etc.

Rationale: The objective of this course is to study various mechanical operations used in chemical industries involving solid-solid and solid-liquid handling, mixing and separation.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	1	2	7	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Learning Objectives: The objective of this course is to study environmental science and technology students about various mechanical operations.

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Particulate Solids:** Introduction, Particle characterization, Concept of sphericity, Mixed particles size, specific surface area and specific number of particles Basic terms in screening, Screen analysis- differential and cumulativeanalysis.	**06**	15
2	**Size Reduction and Screening:** Introduction, Crushing Law, Classification of size reduction equipments, Crushers, Grinders, Ultra-fine grinders, Cutting machines, Open circuit and closed circuit operation, Screen effectiveness, Ideal screen and actual screen, Different screening equipments.	**10**	20
3	**Filtration:** Definition and Mechanisms of filtration, Filtration theory, Filter media and filter aids, Classification of filtration equipments, Selection parameters for filtration equipments, Bag filter in air pollution control, Plate and frame filter press, Rotary drum filter, Leaf filter, Gritte filter, Applications of filtration in waste water treatment.	**10**	25

4	**Sedimentation and Centrifugal Seperation:** Types of settling, Batch sedimentation test, Settling methods, Applications of sedimentation in waste water treatment, Principle, construction and working of sedimentation equipments- Settling tank, Dorr thickener, Lamella clarifier and Tube clarifier. Theory of centrifugal separation, centrifugal filtration, Classification of centrifuges, Simple bowl centrifuge, Disc centrifuge, Tubular-bowl centrifuge, Gas centrifuge.	**10**	25
5	**Solid-Solid and Solid-Fluid Seperation in Environmental Application:** Introduction, Magnetic Seperation, Froth Floatation, Cyclone Separation and Electrostatic Precipitation.	**06**	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
37	22	14	10	7

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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:

- Unit Operations of Chemical Engg. by W.L. McCabe, J. C. Smith & Harriott, 6th Edition Mc-Graw Hill international.
- Chemical Engineering Volume-2, by J. F. Richardson, J. H. Harker and J. R. Backhurst, 4th edition, Butterworth-Heinemann International.
- Introduction to Chemical Engineering by W. L. Badger & J.T. Banchero.
- Principles Of Unit Operations, 2nd Edition, By Alan S. Foust, Leonard A. Wenzel, Curtis W. Wiley-India Publishers.
- Perry's Chemical Engineers handbook, 7th edition by Perry & Green, Mc-Graw Hill International.

Course Outcome:

After learning the course the students should be able to:

1. Understand different properties of particulate solids and methods of out its analysis.
2. Express criteria for selection of specific size reduction equipments based on their final applications in various environmental pollution control methods.
3. Be able to utilize theoretical knowledge for fundamental design of suitable solid liquid separation operation
4. To build a bridge between theoretical and practical concepts of unit operation used in chemical industry to solve environmental pollution problems.

List of Experiments:

1. Screen Analysis
2. Screen Effectiveness
3. Jaw Crusher
4. Roll Crusher
5. Ball Mill
6. Constant Pressure Filtration
7. Batch Sedimentation
8. Cyclone Separator

Design based Problems (DP)/Open Ended Problem:

Minimum **5** practicals to be performed and remaining time should be allotted to open-ended projects / study reports / latest outcomes in technology study **:-**

1. In the beginning of the academic term, faculties will have to allot their students at least one Open-ended Project / Study Report / Latest outcome in technology.
2. Literature survey including patents and research papers of fundamental process

- Design based small project **or**
- Study report based on latest scientific development **or**
- Technology study report/ modeling/ simulation/collection report **or**
- Computer based simulation/ web based application/ analysis presentations of basic concept field which may help them in chemical engineering.

3. These can be done in a group containing maximum **three** students in each.
4. Faculties should cultivate problem based project to enhance the basic mental and technical level of students.
5. Evaluation should be done on **approach of the student on his/her efforts** (not on completion) to study the design module of given task.
6. In the semester student should perform **minimum** 5 set of experiments and complete **one small open ended dedicated project** based on engineering applications. This project along with any performed experiment should be **EVALUATED BY EXTERNAL EXAMINER.**

Major Equipment:

Sieve shaker, Jaw Crusher, Roll Crusher, Ball Mill, Sigma Mixer and Cyclone Seperator.

List of Open Source Software/learning website:

1) www.solidliquidseperation.com
2) www.filtrationandseperation.com

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 is 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 be sent to achievements@gtu.edu.in.