



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE04013021

Subject Name: Unit Operations and Processes in Industries

w. e. f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Basic concepts of Physics, Chemistry & Mathematics.
Rationale:	Provides fundamental knowledge of industrial unit operations and processes to enable environmental engineers to identify and analyze pollution from major industries.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Explain the concepts, types and fundamentals of unit operations and processes.	20
CO-2	Analyze the types of reactors, reactions and mechanisms involved in unit operations commonly found in industries.	20
CO-3	Draw manufacturing process flow diagram of the industrial processes.	30
CO-4	Examine the sources of pollution along with health and safety aspects.	20
CO-5	Apply the principles of waste heat recovery.	10

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	Total no of hours per semester		Theory		Tutorial / Practical			
						ESE (E)	PA / CA (M)	PA/ CA (I)	PBL (I)	ESE (V)	
45	15	0	60	120	4	70	30	20	30	50	200

- **Problem Based Learning (PBL)** aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE04013021

Subject Name: Unit Operations and Processes in Industries

Content:

Sr. No.	Content	Total Hrs
1	Fundamentals of Unit Operations: Definition & types of Unit operations and Unit Process, Fundamentals of fluid flow operation, Heat Transfer operation, Mass transfer operation, Mechanical Operation, basic introduction of material balance and energy balance	03
2	Fundamentals of Unit Processes: Halogenation, hydrogenation, esterification, oxidation, hydrolysis, amination by reduction, sulfonation, Rate of reaction: Zero, First and Second order Reaction, Types of reactors: Batch, Plug Flow, Complete Mix	05
3	Unit Operations in Industries: Theory and mechanisms of Adsorption & desorption, absorption & stripping, evaporation, distillation, liquid – liquid extraction (LLE), filtration, centrifugation, crystallization along with applications in industries.	05
4	Unit Operations & Processes in Fertilizer Industry: Introduction to Fertilizer industries, manufacturing processes of Urea with their uses and applications, sources of pollution, health & safety aspects	05
5	Unit Operations & Processes in Dye & its Intermediates: Classification of Dyes according to its Constitution and Application, Introduction to Disperse, Reactive, Azo, Anthraquinone & Vat dyes, Manufacturing Processes of Vinyl sulphone & H-acid, with their uses and applications, sources of pollution, health & safety aspects	05
6	Unit Operations & Processes in Drugs and Pharmaceuticals: Classification of various drugs and pharmaceuticals, Introduction of Antibiotics, Manufacturing of paracetamol with their uses and applications, sources of pollution, health & safety aspects	05
7	Unit Operations & Processes in Chemical Industries: Introduction to chemical industries, manufacturing process of Monochloroacetic Acid, Nitric Acid, Phenol, Acetic Acid, with their uses and application, sources of pollution, health & safety.	06
8	Unit Operations & Processes in Sugar and Starch Industries: Introduction to sugar industry, manufacturing process with their uses and applications, sources of pollution, health & safety. Sources of Starch, Manufacturing of starch from various sources along with their uses and application, sources of pollution, health & safety.	06
9	Waste Heat recovery in industry: Introduction, benefits of heat recovery, Waste heat recovery systems. <ul style="list-style-type: none">Waste heat devices: Waste heat Recovery boilers, Economizer, air preheater, Recuperators, Regenerator, Heat Wheels, Heat Pipe, Heat Pumps, Thermocompressor, Concept & Types of heat exchangers, Theory and concept s of Logarithmic Mean Temperature Difference (LMTD)	05
TOTAL		45



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE04013021

Subject Name: Unit Operations and Processes in Industries

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	30	20	10	00	00

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. "Unit Operations of Chemical Engineering", McCabe W L, Smith J C, Harriott P, McGraw Hill Publication, 7th edition 2005.
2. "Mass Transfer & Separation Processes", Binay K Dutta, PHI Publications, 2 nd Edition.
3. Austin G. T. Shreve's "Chemical Process Industries", 5th Edition, McGraw Hill (1984).
4. B K. Sharma, "Industrial Chemistry (Including Chemical Engineering)" Krishna Publishing House.
5. Pandey G.N., "A Textbook of Chemical Technology", Volume 1 and 2, Vikas Publications.
6. Kirk and Othmer, "Encyclopedia of Chemical Technology", III Edition.
7. Unit Process by G H Groggins.
8. Chemical Engineering Processes by Dryden.
9. Heat Recovery Systems by D.A.Reay, E & F.N.Span, London, 1979.

List of Open-Source Software/learning website:

1. NPTEL - <https://nptel.ac.in>
2. COURSERA

List of Tutorials:

1. Numericals based on Mass Balance.
2. Numericals based on Energy Balance.
3. Numericals based on Reaction Rate Constant
4. Numericals on Logarithmic Mean Temperature Difference (LMTD).
5. Unit operation & process in Fertilizer Industry along with identification of source of pollution.
6. Unit operation & process in Dye and Dye Intermediate Industry along with identification of source of pollution.
7. Unit operation & process in Pharmaceuticals Industry along with identification of source of pollution
8. Unit Operations & Processes in Chemical Industries with identification of source of pollution.



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE04013021

Subject Name: Unit Operations and Processes in Industries

List of suggested activities for Problem Based Learning:

Sr. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Technical Video based learning related to Adsorption/Desorption Process/Crystallization/Types of absorption units/Liquid-Liquid Extraction/Distillation and working of Heat recovery equipment and Process in chemical industries	Duration of video: 10 hrs	Multiple choice questions-based Assessment
2.	Solve the Numerical related to following topics. <ul style="list-style-type: none">• Logarithmic Mean Temperature Difference• Mass balance• Energy balance• Rate of reaction	Duration: 08 hrs	Based on submission of given tutorial
3.	Poster preparation on different types of reactors with applications	Duration: 06 hrs	Based on submission of poster
4.	Prepare a Poster on Process flow diagram of given industry and identify sources of pollution along with health & safety aspects	Duration: 06 hrs	Based on submission of poster
5.	Prepare a poster with different symbols used Chemical/Environmental Processing Engineering	Duration: 04 hrs	Based on submission of poster
6.	Prepare a report for safety guidelines of given industry	Duration: 06 hrs	Based on submission of report
7.	Prepare a poster presentation on various heat recovery equipment's	Duration: 06 hrs	Based on submission of poster/ report
8.	Industrial Visit	Visit: 8 hrs Report preparation: 4hrs Total: 12 hrs	Based on the report submission
9.	Preparation of technical report from reference book/research paper related to unit processes an operation in Chemical Industries	Duration: 10 hrs	Based on Report preparation
