



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3140508

Semester – IV

Subject Name: Unit Processes & Chemical Technology

**Type of course:** Basic Science.

**Prerequisite:** Basic Organic and Inorganic Chemistry

**Rationale:** Chemical Unit Processes is essential for chemical engineering as it gives an overview of all chemical process industries.

### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Pr/Viva (V)	PA (I)	
4	0	2	5	70	30	30	20	150

### Contents:

Sr. No.	Topics	Teaching Hrs.
1	<b>Mechanisms and recent advances of following unit processes:</b> Alkylation and Acylation, e.g. alkylation of benzene, phenols, etc. Halogenation, e.g. chlorination of toluene, Nitration and Sulfonation, e.g. nitration, sulfonation of benzene, etc. Hydrogenation and Reductive Alkylations, e.g. hydrogenation of nitrobenzene, reductive alkylation reactions of anilines, Oxidation, e.g. oxidation of xylenes, etc.	06
2	<b>Sulphur, Sulphuric acid &amp; Fertilizer Industries:</b> Mining and manufacturing of Sulphur, Manufacture of Sulphuric acid by DCDA process and its applications. Sulphur trioxide, Sodium Sulphate, Sodium Thiosulphate, Manufacturing technologies & associated Engineering problems. Introduction to Fertilizer industries, manufacturing processes of Ammonia, Urea, Nitric acid, Phosphoric acid their uses and applications, major engineering problems, NPK fertilizer.	10
3	<b>Chlor-alkali and Heavy Inorganic industry:</b> Manufacturing of Caustic Soda and Chlorine by membrane cell, mercury & diaphragm process, Manufacturing of Sodium Bicarbonate.	04
4	<b>Dye &amp; its Intermediates, Paints and Pigment Industries:</b> Classification of Dyes according to its Constitution and Application, Introduction to Disperse, Reactive, Azo, Anthraquinone & Vat dyes, Manufacturing Processes of Chrome blue black, H-acid, Koch acid, Vinyl sulphone, Vat dyes. Introduction to Paints classification & its constituents, PVC of Paints, Different types of pigments such as white, blue, red, yellow, green, brown. Introduction to Varnishes, Solvent & Thinners & Industrial Coatings.	08



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5	<b>Drugs and Pharmaceuticals:</b> Classification of various drugs and pharmaceuticals, Introduction of Antibiotics, Manufacturing of penicillin, Introduction of vitamins, Manufacturing processes of Aspirin, Vitamin-D, B-12, & C (Ascorbic acid), Introduction to Barbital & Phenol Barbital.	06
6	<b>Sugar &amp; Fermentation Industries:</b> Manufacturing of Sugar. Fermentation, Industrial Alcohol, Absolute Alcohol, Beers, Wines and Liquors, Manufacturing of Butyl Alcohol & Citric acid by fermentation.	05
7	<b>Cement &amp; Ceramic Industries:</b> Cement & Its types, Settling & Hardening of Cement, Cement manufacturing by wet & dry process. Introduction to Ceramic Industry, Manufacturing of Building bricks, Refractory & its types.	06
8	<b>Introduction to pulp and paper industries:</b> Pulp manufacturing by Kraft process, Difference between sulphate & sulphite process, Manufacturing of Paper.	04
9	<b>Petroleum Refinery and Petrochemicals:</b> Introduction to basics of refinery, Important properties of petroleum products, Processing of petroleum and treatment techniques, cracking etc. Introduction of C1, C2, C3, Petrochemical aromatics and polymers.	08

## 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	05	05	05

**Legends: R: Remembrance; U: Understanding; A: Application; N: Analyze; 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. Dryden, C. E. "Outlines of Chemical Technology" (Edited and Revised by M. Gopala Rao and M. Sittig) East West Press. Pvt. Ltd, New Delhi, 3 rd Edition (1997).
2. Austin G. T. Shreve's "Chemical Process Industries", 5th Edition, McGraw Hill (1984).
3. B K. Sharma, "Industrial Chemistry (Including Chemical Engineering)" Krishna Publishing House.
4. James A Kent, "Riegel's Handbook of Industrial Chemistry" Springer Publication.
5. A H Patel, "Industrial Microbiology" Trinity Press, Laxmi Publication Pvt Ltd.
6. M Gopala Rao, Marshall Sittig, "Outlines of Chemical Technology" Affiliated East West Press (Pvt) Ltd.
7. Encyclopedia of Industrial Chemistry, Ullmann, VCH, 1996.
8. Industrial Organic Chemistry, Weissermel K & Arpe H.J., Weinheim, 1978.
9. Pandey G.N., "A Text Book of Chemical Technology", Volume 1 and 2, Vikas Publications 11. B. S. Mitchell.



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10. An Introduction to Materials Engineering and Science for Chemical and Materials Engineers, John Wiley & Sons, 2004.
11. Kirk and Othmer, "Encyclopedia of Chemical Technology", III Edition.
12. Srikumar Koyikkal, "Chemical Process Technology and Simulation", PHI Learning Ltd (2013).
13. Unit Process by G H Groggins.

## Course Outcome:

Sr. No.	CO Statements	Marks % Weightage
1.	Develop fundamental understanding of the process carried out in chemical industry.	30%
2.	Explain the basic reaction steps involved in the production of various grades of products.	21%
3.	Construct process flow diagrams for different chemical manufacturing plants.	28%
4.	Predict all possible trouble shootings arise in chemical plants.	7%
5.	To review the practical importance and relevance of process takes place in chemical industry.	7%
6.	Resolve all technological and economical problems arise in the chemical manufacturing plants.	7%

## LIST OF PRACTICALS: (Minimum 10 need to be performed)

Sr. No.	List of Experiments
1.	To prepare soap in the laboratory and carry out its cost analysis.
2.	To determine saponification value of oil sample
3.	To prepare detergent in the laboratory and to carry out its cost analysis.
4.	To determine the acid value of the given sample of oil.
5.	To prepare hydrated lime from the given calcium carbonate powder
6.	To prepare caustic soda by chemical method.
7.	To synthesis aspirin from salicylic acid.
8.	Preparation of phenyl azo – $\beta$ – Naphthol from aniline.
9.	Preparation of disperse dye.
10.	To prepare mordant yellow dye.
11.	Preparation of fast green o dye.
12.	Preparation of nitro benzene from benzene.
13.	To study Alcohol Fermentation by <i>Saccharomyces cereviceae</i> (Baker's Yeast).
14.	Fermentative production of citric acid using the fungi <i>Aspergillus niger</i> .

## Reference Books:

1. Vogel's Textbook of Practical Organic Chemistry by Hannaford, Smith & Tatchell, Publisher: Elbs with Longman
2. Vogel's textbook of Quantitative/ Qualitative Chemical Analysis, by Arthur I Vogel, Revised by Jeffery et al, Publisher: Addison Wesley, Longman Ltd, England
3. Engineering Vogel's Textbook of Quantitative Chemical Analysis by Jeffery. G H Publisher: Addison Wesley Longman/Pearson Education Asia.

## Major Equipment:

1. Laboratory Oven, Stirrer Hot Plate, Hot plates.



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2. Electronic Balance.

**List of Open Source Software/learning website:**

NPTEL, World Wide Web, etc.