

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING

ORGANIC CHEMISTRY AND UNIT PROCESSES

SUBJECT CODE: 2130501

B.E. Semester: III

Type of course: Chemical Engineering.

Prerequisite: Students having background of chemistry at higher secondary level.

Rationale: It is the basic subject for Chemical Engineering Students.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	General Principles of Organic reactions and Mechanisms: Fission Reaction and reaction intermediates: Free Radical, Carbonium, Carbanion, Carbenes and Nitrenes. Nucleophilles and Electrophilles. Types of Organic reactions and its mechanism: Especially Nucleophilic and Electrophilic Addition and Substitution reactions.	6	60 %
2	Stereochemistry: Optical, Geometrical and Conformational Isomerism: Optical activity, Polarimeter, Specific rotation, Enantiomers, Diastereomers, Optical activity in Lactic and Tartaric acid, R and S configuration of Optically active compound and E and Z designation of Geometrical isomers. Resolution of racemic mixture.	4	
3	Introduction to various Unit Processes and Operations: Nitration, Amination, Hydrogenation, Halogenations, Oxidation, Reduction, Sulphonation, Hydrolysis, Alkylation and Polymerization.	6	
4	Carboxylic acid : Introduction, Preparation and Properties Manufacture Process of Acetic acid, Formic acid, Oxalic acid, Palmitic acid & Stearic acid Derivatives of Carboxylic acids: Acid Amides, Esters, Acid Anhydrides and Acid Chlorides. Mechanism of Esterification and Strengths of Acids.	4	
5	Polynuclear and Heterocyclic Compounds:	4	

	Introduction and Classification. Preparation, Properties and Uses of: Naphthalene, Anthracene, Pyrrole, Furan, Thiophene, Pyridine and Quinoline		
6	Application of following reactions with Mechanism: Diazotisation, Sandmeyer, Cannizzaro, Wolf Kishner, Claisen, Curtius, Baeyer Villiger, Hoffman and Michael Dieckmann reaction.	5	
7	Carbohydrates: Introduction, Classification, Configuration and Chemical reactions of mono, oligo and poly saccharides, especially of Glucose, Fructose and Starch. Conversion of higher to lower and lower to higher aldose (Killiani Synthesis, Ruff & Wohl's Degradation). Conversion of Aldose to Ketose. Manufacturing of Cane Sugar from Sugarcane with flow sheet.	4	40%
8	Amino acid & Protein Chemistry: Introduction, Composition, Classification & Isolation of Proteins, Qualitative tests of Proteins, Classification of Amino acids & their synthesis. Amphoteric nature, Isoelectric point, Primary, Secondary, Tertiary and Quaternary Structure of Protein, RNA and DNA.	4	
9	Synthetic Drugs: Synthesis of drugs, Antiseptics, Halogenated compounds, Antimalarials, Quinoline derivatives, Antibacterials, Sulpha Aspirin, Phenacetin, Paracetamol, Sulphanilamide, Sulphaguanidine, Chloromycetin, Chloroquine.	6	
10	Colour, Dyes and Pigments: Introduction, Classification of dyes based on Application and Structural representation. Colour and Constitution Theory: Quinonoid, Valence bond and Molecular Orbital theory Application of Dyes and Pigments. Preparation of some imp derivatives: Congo red, Malachite Green, Crystal Violet, Alizarin, Phenolphthalein, Fluorescein, Eosin and Indigo .	5	
11	Petroleum Chemistry: Occurrence- Composition of Crude oil- Distillation of the Crude oil, Cracking, Knocking, Octane number & Cetane number, Synthetic petrol.	6	

Reference Books:

Sr. No.	Title/Author/Publisher
1.	A Text Book Of Organic Chemistry by P. L. Soni, Sultan Chand & Sons, New Delhi.
2.	A Text Book of Organic Chemistry by Arun Bahl and B.S. Bahl, Sultan Chand & Sons, New Delhi
3.	A Textbook of Organic Chemistry by Raj K Bansal, New Age International, New Delhi
4.	Organic Chemistry By Solomons, John Willey & Sons, USA.
5.	Organic Chemistry, I. L. Finar Vol. I & II ELBS & Longmans, Green – UK
6.	Organic Chemistry

	By Morrison and Boyd, Pearson Education, Singapore.
7.	A Textbook of Organic Chemistry By Francis A Carey, Springer –USA
8.	Organic Reaction and their Mechanisms By P S Kalsi, New Age International, New Delhi
9.	Atomic Structure and the Chemical Bond By Manas Chanda, Tata Mcgrawhill
10.	Heterocyclic Chemistry By Bansal B K, New Age International, New Delhi
11.	Organic Chemistry By R L Madan, S. Chand & Company, New Delhi
12.	Laboratory Techniques in Organic Chemistry By Ahluwalia V K, I K International, New Delhi
13.	Unit Process in Organic Synthesis By P H Groggins, Tata Mc Graw Hill, New Delhi.
14.	Vogel's textbook of Qualitative Organic Analysis, By Arthur I Vogel, Revised by Jefferey et al. Publisher: Addison Wessley Longmann Ltd, England

Course Outcome:

After learning the course the students should be able:

1. To build a basic knowledge of the Fundamental structure of Organic molecules.
2. To analyze scientific concepts and think critically.
3. To understand and explain the reactions in Organic molecules.
4. To correlate the same as per their utility in field of Chemical Engineering.

List of Experiments and Open Ended Projects:

Minimum 5 practicals to be performed and remaining 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 Projects / Study Reports / Latest outcomes in technology.
2. Literature survey including patents and research papers of basic chemistry
- 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 applied science field which may help them in chemical engineering fields .
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**.

LIST OF PRACTICALS: (Minimum 5 out of any three set to be performed.)

(I) Qualitative analysis of different Organic molecules :

1	ACIDS	:	Benzoic, Salicylic, Cinnamic, Sulphanilic, Anthranilic
2	PHENOLS	:	alpha-Naphthol, beta-Naphthol, Resorcinol
3	BASES	:	Aniline, o-m and p-Nitro aniline, p-Toluidine, Diphenylamine

4	ALDEHYDES KETONES ESTERS	:	Benzaldehyde Acetone, Methyl ethyl ketone Methyl acetate, Ethyl acetate
5	ALCOHOLS	:	Ethyl alcohol, Methyl alcohol
6	HYDROCARBONS	:	Benzene, Toluene
7	CARBOHYDRATES	:	Glucose, Fructose
8	AMIDES	:	Urea, Benzamide
9	ANILIDES	:	Acetanilide
10	HALOGENATED COMPOUNDS	:	Chlorobenzene, Bromobenzene

(II) Organic Estimation by volumetric method of any two of the following :

1. Estimation of Phenol by Bromination.
2. Glucose by Hypiodite method.

(III) Organic preparations of any two of the following :

1. Acetanilide from aniline.
2. Tribromophenol from Phenol.
3. m-dinitrobenzene from Nitrobenzene.
4. Anthraquinone from Anthracene.
5. Phthalic anhydride from Phthalic acid.

Open Ended Project fields:-

Students are free to select any area of organic chemistry and unit process based to define project. Some suggested projects are listed below:

- Detailed study of any unit process like nitration,halogenations,etc.
- Product profile and its manufacturing product any organic compound in detail.

Major Equipments:

- Magnetic Stirrer, Hot plates.
- Laboratory Oven.
- Melting Point Instrument,etc.

List Of Open Source Software/Learning Website:

Students can refer various video lectures available on NPTEL, refer soft copies (CD) provided with reference books/text books , etc.

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.