

**BACHELOR OF SCIENCE - Industrial Chemistry Vocational – Sardar Patel University - Semester-V - PAPER NO.: US05CICV51 - TITLE: Organic Chemistry - (04 Credits, 4 Hours/Week; 70 External Marks & 30 Internal Marks) - (Effective from June2023)**

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**COURSE OUTCOMES:** In this paper of organic chemistry, students will learn about heterocyclic compounds, their properties and synthesis. They will also learn about various name reaction and reagents utilized for chemical reactions having direct applicability in the industries. Also, students will get exposed to the basics of spectroscopy and its application in organic chemical analysis.

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Unit 1: Heterocyclic Chemistry: Nomenclature of heterocyclic systems (Five and Six membered only), Five membered heterocycles- structure, source and electrophilic substitution reaction in Pyrrole, Thiophene and furan. Six membered heterocyclic compounds: structure and source of pyridine compounds, nucleophilic and electrophilic substitution reaction in pyridine, basicity of pyridine, reduction of pyridine. Fused ring heterocycles- Skraup synthesis of Quinoline, Bischler-Nspierlaski synthesis of isoquinoline, Fischer indolesynthesis.

Unit: 2 Stereochemistry: Stereoisomerism, Polari meter, specific rotation, chirality, enantiomers, Racemic modification, optical activity, configuration, specification of configuration: R & S, diastereomers, meso compound, conformational isomers, reactions involving stereoisomers.

Unit: 3 Some Reagents Of Synthetic Importance: Aluminium isopropoxide, Diazomethane, N-Bromosuccinimide, Lead tetra acetate, Osmium tetraoxide, Selenium dioxide,  $\text{LiAlH}_4$  and  $\text{NaBH}_4$ . Reaction Mechanism:, Hoffmann- Loffler Reaction, Baeyer Villiger Oxidation, Hunsdiecker Reaction, Favorskii Rearrangement, Benzoin Condensation ,Concept of rearrangement - Beckman Rearrangement, Benzilic acid Rearrangement and Pinacol- Pinacolone rearrangement.

Unit: 4 Ultraviolet (UV) and Visible Spectroscopy: An Introduction, electronic transitional definition of some terms and designation of UV absorption bands. Infrared Spectroscopy: An introduction, Instrumentations, Applications of IR spectroscopy, Interpretation of IR spectra- characterization of functional groups and structural diagnosis. NMR Spectroscopy: PMR spectroscopy, shielding and deshielding , chemical shift, spin-spin splitting and coupling constant, area of signal, interpretation of PMR spectra of various simple organic molecules, Problems pertaining to the structure elucidation of organic compounds using UV, IR, Mass and PMR spectroscopy.

**REFERENCEBOOKS**

Organic Chemistry by Robert T. Morrison and Robert T. Boyd ( VIth Edition, Prentice Hall of India Pvt. Ltd. New Delhi) - Organic Chemistry by R. K. Bansal (Tata McGraw – Hill Publishing Co. Ltd. New Delhi) - Organic Chemistry by M. K. Jain and S. C. Jain (ShobanLAINagin Chand & Co. Educational Publishers, Jalandhar). - Spectroscopy of Organic Compounds by P. S. Kalsi (New Age International Publishers) - Spectroscopy (Atomic & Molecular) by GurdeepChatwal (Himalaya Publishing House).

**Bachelor of Science - Industrial Chemistry Vocational – Sardar Patel University - Semester-V - PAPER NO.: US05CICV52 - TITLE: Technology of Petroleum & Petroleum Products - (04 Credits, 4 Hours/Week; 70 External Marks & 30 Internal Marks) - (Effective from June 2023)**

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**COURSE OUTCOMES:** This paper will inculcate knowledge of petroleum industry. The source of petroleum, process of rectification of crude and obtaining petroleum fractions and various fuels. Additionally, students will learn the manufacturing of various chemical entities derived from petroleum source. Also, they will learn the analytical aspects of petroleum raw material, fuels and products derived thereof.

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Unit 1 Introduction - Nomenclature Generic names, Trade names, Theories of Formation, Composition and its testing methods. Refining and Rectification process of Petroleum.

Unit 2 Manufacture of the following compounds: Methane, ethylene, acetylene.

Preparation of the following from methane, methanol, hydrogen cyanide, carbon disulphides. Unit 3 Preparation of the following from ethylene. Ethyl chloride, ethanol, ethylene oxide, ethylene glycol, acetic acid, styrene, vinyl acetate.

Manufacture of the following compounds: From propylene: Isopropanol, Cumene, glycerin, acrylonitrile.

Unit 4 Manufacturing from C-4 hydrocarbons: Butadiene, Isobutene, Isobutane, Butanediols. Production of Benzene, Toluene, Xylene, Naphthalene, linear alkyl benzenes sulphonate.

Various catalysts used in petrochemical industry: Preparation, applications and selectivity.

**REFERENCE BOOKS**

1. Handbook of Petroleum Refining Process R. A. Meyers, McGraw Hill, Book Com. NewYork.
2. From Hydrocarbons to petrochemicals, L.F. Hatch Gulf Publishing company, Houston.
3. Petrochemicals – The vise of an industry, Spitz,Willey.
4. Introduction to petrochemicals by Sukumar Mati,IBH.
5. Introduction to petroleum chemicals, M. Steiner, PergamanPress.
6. Catalysts in petrochemcial refining,Trima.Billmeyer.
7. A Text on Petrochemicals by BhaskarRao (Khanna Publishers - NewDelhi)
8. Modern Petroleum Refining Process by BhaskarRao (Oxford & IBH Publishing Co. Pvt. Ltd. – NewDelhi)
9. Advanced Petrochemicals by Dr. G. N. Sarkar (KhannaPublishers)
10. Advanced Petroleum Refining by Dr. G. N. Sarkar ( KhannaPublishers)
11. Chemicals from Petroleum by A. L. Waddam. (ELBS edition,London.)
12. Shreve’s Chemical Process Industries by Austin (MacGrow- Hill Publication, New Delhi).

**Bachelor of Science - Industrial Chemistry Vocational – Sardar Patel University - Semester-V - PAPER NO.: US05CICV53 - TITLE: Heavy & Fine Chemicals - (04 Credits, 4 Hours/Week; 70 External Marks & 30 Internal Marks) - (Effective from June 2023)**

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COURSE OUTCOMES: This paper will help students to understand the properties of heavy and fine chemicals. They will also learn various manufacturing processes of specialty chemicals, the raw material required and the process parameters involved. Also, they will learn the application of various chemicals as raw materials.

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UNIT-1: Synthetic nitrogen products – Ammonia, ammonium nitrate and ammonium sulphate, nitric acid, Phosphorous chemical – phosphorus, phosphoric acid, ammonium phosphate, super – phosphate, triple superphosphate. Industrial carbon – carbon black, manufacture of graphite and carbon, lime, gypsum, silicon, calcium carbide, silicon carbide. Fluorine, Bromine, Iodine, Inter-halogen compound. Sodium chloride, sodium sulphate, sodium sulphite, sodium thiosulphate. Industrial catalysts – Raney nickel, other forms of nickel, palladium and supported palladium, copper chromate, vanadium, platinum-based catalyst, titanium tetrachloride, and titanium dioxide.

UNIT-2: Fine and specialty chemicals – sodium carbonate, sodium bicarbonate, potassium dichromate, oxalic acid, perchloric acid, Fehling solution, Karl-Fischer reagent, sodium borohydrate, sodium ethoxide, sodium methoxide and lithium aluminium hydride.

Biochemical reagents: Ninhydrin, tetrazolium blue, 1,2-naphthaquinone – 4 – sulphonate manufacture of following fine chemicals. Chromatographic materials and HPLC Solvents: Coating materials, precoating of plates, spectroscopy grade chemical. Methanol, ethanol, potassium bromide, carbon tetrachloride, Nujol, chloroform.

UNIT-3: Fischer-tropsch synthesis- Examples, Chemicals derived from acetylene, propargyl alcohol, 1, 4-butanediol, acrylates, vinyl esters, vinyl chloride. Pyridine picolines, phenol, acetone, resorcinol, phthalic anhydride.

Raw materials, flow chart, effluent management, kinetics and uses of Triphenyl phosphine, alkyl phosphates, Glycerol, sorbitol, melamine, formaldehyde, formic acid.

UNIT-4: Chlorination of methane: Methyl chloride, dichloromethane, chloroform, carbon tetrachloride. Ethanolamine, mono, di, and tri- ethanolamines, dialkylaminoethanols (dimethyl, diethyl). Alkylamines: Methylamine, ethylamine, di, tri - alkylamine (methyl, ethyl), butylamines, propyl amines Specialty & industrial solvents: DMF, DMSO, Sulfolane, Alkylpyrrolidone, THF, Dibutyl ether, diethyl ether, dimethoxyethane, dioxane.

REFERENCE BOOKS:

1. Chemical process industries, Shreve RN, McGrawHill., Introduction to material science and engineering, K M RELLS and T. COURTNEY, Wiley Eastern Pvt. Ltd. NewDelhi., Outline of Chemical Technology, G E. Dryden, East West Press, NewDelhi.
2. Industrial Chemicals, Faith et. al. Wiley Interscience, NewDelhi.
3. Applied Organic Chemistry, Kilner E. and Samuel.D.M.MacDonald and EvansLtd.,
4. Unit process in Organic Synthesis. P.H. roggGine, McGraw Hill KogakusinLtd.
5. Heavy organic chemicals, A.J.Saite, Pargaon Press,U.K.

**Bachelor of Science - Industrial Chemistry Vocational – Sardar Patel University - Semester-V - PAPER NO.: US05CICV54 - TITLE: Mass Transfer - (04 Credits, 4 Hours/Week; 70 External Marks & 30 Internal Marks) - (Effective from June 2023)**

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COURSE OUTCOMES: This paper will help students understand the engineering concepts

of mass transfer. It will detail the concepts of separation, distillation and its types. Also it will help students to understand the process of purification by crystallization as well as drying techniques utilized at industrial level for mass production in chemical plants.

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Unit 1 Characterization, uses and selection of separation process – Distillation, Types of distillation, McCabe Thiele method for calculating Number of Theoretical plates, Importance of Reflux Ratio, Types of trays.

Unit 2 Concept of Mass Transfer Operations, Fick's Law, Gas absorption, Equipment's for Gas absorption, Solvents for Gas absorption, Importance of packing in packed towers and Types of packing, Liquid Extraction & Equipment's of liquid Extractions.

Unit 3 Crystallization- Methods of crystallization, Batch & Continuous crystallization, Theory of crystallization, Mechanism of crystallization, Mass & Enthalpy Balance calculations. Leaching, Factors affecting leaching, Industrial leaching examples.

Unit 4 Drying, Classification of dryers, Compartment dryer, Tunnel dryer, rotary dryer, Drum dryer, Spray dryer etc., Types of moisture, Theory of drying.

Evaporation- batch and continuous type evaporators, Multiple effect evaporator, Capacity of evaporator, Accessories of evaporator.

REFERENCE BOOKS:

1. Unit Operations: Volume I & II, by K. A. Gavhane( NiraliPrakashan-Pune)
2. Introduction to Chemical Engineering by Walter L Badger and Juline T Banchero (McGraw-Hill BookCo.)
3. Unit Operation of Chemical Engineering by Warreh L Mc Cabe&Jullian C Smith (McGraw-Hill BookCo.)
4. Chemical Engineering (volume I & II) by J. M. Coulson & K. F. Richardson (Asian Books Pvt. Ltd., NewDelhi)

**Bachelor of Science - Industrial Chemistry Vocational – Sardar Patel University - Semester-V - SUBJECT CODE: US05CICV55 - TITLE: Practical (All Core Courses) - (08 Credits, 16 Hours; External Marks-140, Internal Marks-60) - (Effective from June 2023)**

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COURSE OUTCOMES: This paper of practical will provide hands on exposure to students towards preparation and estimation of Intermediates and Drugs based on various Unit Process. Also, it will help students to learn analysis of petroleum and petroleum (as per ASTM testing procedure). Also, it will help students to understand about Pharmaceutical Packaging materials, quality control tests of some materials and analysis of Active ingredient from few types of formulations representing different methods of analysis.

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Part-I: (02 Credits, 04 Hours, 35 External 15 Internal marks)

Preparation and Estimation of Intermediates and Drugs based on various Unit Process. Part: II: (02 Credits, 04 Hours, 35 External 15 Internal marks)

As per ASTM testing of petroleum and petroleum products: Characteristics of Petrol, Kerosene, Diesel, Furnace Oil, with respect to Flashpoint, Viscosity, Surface Tension, Distillation Fractions.

Part: III: (02 Credits, 04 Hours, 35 External 15 Internal marks)

Preparation of Ammonium Nitrate, Vinyl Esters, Vinyl Chloride, Phthalic Anhydride and phthalamide. Preparation, purification and estimation of fine and specialty chemicals, Preparation of various industrial metal supported catalyst, Extraction and purification of industrial solvent., Physical and performance parameter of coating.

Part: IV: (02 Credits, 04 Hours, 35 External 15 Internal marks)

Demonstration of various Pharmaceutical Packaging materials quality control tests of some materials. Aluminum strips, cartons, glass bottles. Limits tests for chlorine, heavy metals, arsenic etc. of two representative bulk drugs. Demonstration of various pharmaceutical products. Active ingredient analysis of few types of formulations representing different methods of analysis acidimetry, Alkalimetry, nonaqueous complexometric, Potentiometry, etc. of bulk drugs, complete I.P. Mono graph of three drugs representing variety of testing methods. And estimations.