



(Bachelor of Science)(Undergraduate) (Industrial Chemistry Vocational)
B. Sc. (UG) Semester –III (Effective from JUNE 2022)

Course Code	US03CICV51	Title of the Course	Chemical Plant Auxiliaries and Manufacturing
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Basis of Water- Impurities and hardness of natural water. 2. Concepts of Compression process. 3. Basic concepts of Nitration process and oxidation process.
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Course Content		
Unit	Description	Weightage* (%)
1.	Water- Impurities and hardness of natural water, Water for steam making and industrial processes, Boiler water treatments, Calculation on water treatment, Fuel - classification, Advantages and disadvantages, Analysis of fuels, Heating media, Air- Specification for industrial uses of air. Industrial applications of CO ₂ , O ₂ , N ₂ and H ₂ .	25%
2.	Compression equipments, Reciprocating compressor, Work of single stage reciprocating compressor, Effect of clearance, Volumetric efficiency, Multistage compression, Refrigeration, COP & refrigerating effect, Industrial refrigerant, Carnot and other refrigeration cycles, Internal combustion engines and external combustion engines, Steam power plant, Its working and thermodynamic analysis, Otto engine and Diesel engine, Steam boilers - Their classification, Steam generation, Conditions of steam, Steam table.	25%
3.	Nitration - Introduction, Nitration agents, Continuous vs batch nitration, Benzene to nitrobenzene and m-dinitrobenzene, Chlorobenzene to ortho and para nitro - chlorobenzene, Acetanilide to p-nitroacetanilide, Amination - by reduction - Introduction, Methods of reduction, Metal and acid, Catalyst sulfide, electrolytic, Metal and alkali sulfites, Metal hydrides, Sodium metal, concentrated caustic oxidation, Reduction, Reduction commercial manufacturing of aniline, m-nitroaniline. Sulphonation - Introduction, sulphonating agents, Kinetics and mechanism of sulphonation reaction, Commercial	25%





	sulfonation of benzene.	
4.	Oxidation - Introduction, Types of oxidation reactions, Oxidizing agents, Liquid phase oxidation, Vapor phase oxidation, Commercial manufacture of benzoic acid, Phthalic anhydride, Acetic acid. Halogenation- Introduction, kinetics of halogenation reactions, Reagents for halogenation, Commercial production process of Chlorobenzene & Monochloro acetic acid. Hydrogenation- Introduction kinetics, Catalysts for hydrogenation reactions, Hydrogenation of vegetable oil. Esterification- Introduction, Esterification of carboxylic acid derivatives, Commercial manufacture of ethyl acetate. Hydrolysis - Introduction, Hydrolysis agents & mechanism of hydrolysis.	25%

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Industrial Chemistry Vocational programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to ---	
1.	Learn about basic concepts of Compression, water analysis, Nitration and oxidation process.
2.	Apply knowledge in further studies of third year B.Sc. Industrial chemistry Vocational course.





Suggested References:

Sr. No.	References Books
1.	Chemistry of Engineering Materials by C. V. Agrawal (Tara Publication).
2.	Introduction to Chemical Engineering Thermodynamics (IV edition) by J. M. Smith & Vanness, (McGraw-Hill Co.)
3	Chemistry in Engineering and Technology, (volume I & II) J C Kuriacose & J. Rajaral (Tata McGraw Hill).
4	Chemistry of Engineering Materials By Jain & Jain. (Dhanpairai Publishing Co.).
5	Shreve's Chemical Process Industries by George T. Austin (McGraw-Hill, Publication, New Delhi).
6	Unit process in Organic synthesis, P. H. Groggins, Mcgraw- Hill Book Co., New York.

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web





(Bachelor of Science)(Undergraduate) (Industrial Chemistry Vocational)
B. Sc. (UG) Semester –III (Effective from JUNE 2022)

Course Code	US03CICV52	Title of the Course	Fundamentals of Organic Chemistry
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Basis of Fundamental Aspects In Organic Chemistry. 2. Concepts of Phenols, Alcohols, Ethers and Epoxides. 3. Basic concepts of Aldehydes, Ketones, Carboxylic Acids And their derivatives.
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Course Content		
Unit	Description	Weightage* (%)
1.	Fundamental Aspects In Organic Chemistry: Hybridization, Sigma and pi - bonds, Hydrogen bond, Inductive effect, Electronic effect, Resonance effect, Hyper-conjugation, Steric effect, Acid and bases, Definition, structure and stability of free-radical, Carbocation, Cabanion, and Benzyne, Energy profiles.	25%
2.	Phenols, Alcohols, Ethers and Epoxides: Phenols -Structure, Nomenclature, Preparation, Physical properties, Salts of phenol, Acidity of phenols, Reactions. Alcohols - Structure, Classification, Nomenclature, Preparation, Physical properties, reactions, Alcohols as acids and bases, Synthesis using alcohols, Formation of 1,2-diols, Analysis of 1,2-diols, Oxidation cleavage of polyhydroxy-alcohols. Ethers - Structure, Nomenclature, Preparation, Physical properties, Reactions, Cyclic ethers. Epoxides - Preparation and reactions.	25%
3.	Aldehydes, Ketones, Carboxylic Acids And their derivatives: Structure, Classification, Nomenclature, Preparation, Physical properties, Nucleophilic addition reactions, Base promoted halogenation of ketones, Acid catalyzed halogenation of ketones. Structure, Nomenclature, Preparation, Physical properties, Salts of carboxylic acids, Acidity of carboxylic acids, Effect of substituents on acidity, Reactions, reactions of acid chloride, Acid anhydrides,	25%





	Amides and esters. Preparation of malic acid and tartaric acid from maleic acid, preparation of citric acid from glycerol.	
4.	Amines And Diazonium Salts Amines-Structure, Nomenclature, Preparation, Hoffman rearrangement, Physical properties, Salts of amines, Basicity of amines, Effect of substituents on basicity, reactions, Hoffman elimination, Analysis of amines, Phase transfer catalyst. Diazonium salts - Synthesis, reaction and characteristics.	25%

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Industrial Chemistry Vocational programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to ---	
1.	Learn about basic concepts of fundamental aspects In Organic Chemistry, Phenols, Alcohols, Ethers and Epoxides, Aldehydes, Ketones, Carboxylic acids and their derivatives, Amines And Diazonium Salts.
2.	Apply knowledge in further studies of third year B.Sc. Industrial chemistry Vocational course.

Suggested References:	
Sr. No.	References Books





SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.25))
Syllabus with effect from the Academic Year 2022-2023

1.	Organic Chemistry by M. K. Jain and S. C. Jain (Shoban LAI Nagin Chand & Co. Educational Publishers, Jalandhar).
2.	Organic Chemistry by Robert T. Morison and Robert T. Boyd (Vth Edition, Prentice Hall of India Pvt. Ltd. New Delhi).
3	Organic Chemistry by R. K. Bansal (Tata McGraw - Hill Publishing Co. Ltd. New Delhi).

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web





(Bachelor of Science)(Undergraduate) (Industrial Chemistry Vocational)
B. Sc. (UG) Semester – III (Effective from JUNE 2022)

Course Code	US03CICV53	Title of the Course	Practical
Total Credits of the Course	4	Hours per Week	8

Course Objectives:	To make students familiar with: 1. Practical aspects of preparation of solutions & its standardization. 2. Hands on experience of water analysis, binary organic mixture separation, identification and derivatives preparation.
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Course Content	
Practical	Description
I	Water analysis - suspended solids, total dissolved solids, carbonate and bicarbonates, sulfate as BaSO ₄ , chlorine content, Ca & Mg, acidity and total hardness etc., Preparation and estimation of organic compounds based on various unit process.
II.	Organic Spotting of a binary mixture, separation, identification and derivatives preparation. Experiment based on lab skill enhancement for preparation of laboratory (Preparation and Standardization of laboratory solution).

Teaching-Learning Methodology	Hands on training of Practical's. Courses for B. Sc. Industrial Chemistry Vocational programme are delivered through laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr.No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	---
2.	Internal Continuous Assessment in the form of Practical, Viva-voce,	--





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	Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	
3.	University Examination	100%

Course Outcomes: Having completed this course, the learner will be able to

1.	Learn about separation and identification of binary organic mixture and water analysis.
2.	Apply knowledge in further studies of third year B.Sc. Industrial chemistry Vocational course.

Suggested References:

Sr. No.	References Books:
1.	Vogel's Textbook of Quantitative Chemical Analysis, 5 th Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web





(Bachelor of Science)(Undergraduate) (Industrial Chemistry Vocational)
B. Sc. (UG) Semester –IV (Effective from JUNE 2022)

Course Code	US04CICV51	Title of the Course	Fluid Mechanism and Heat Transfer
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Basis of Fluid machineries. 2. Concepts of heat transfer equipment.
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Course Content		
Unit	Description	Weightage* (%)
1.	Fluids and their Classification, Viscosity, Newtonian Fluids, Static pressure, Manometer, Mechanism of fluid flow, Types of flow, Continuity equation, Bernaulli's theorm, Friction factor and Friction head.	25%
2.	Fluid moving machineries, Equipments, Pipes and pipe fittings, Pumps- classification and performance, Reciprocating and Rotary pumps, Centrifugal pumps, Blower, Compressors, Vacuum pump.	25%
3.	Modes of heat transfer, Flourier's law, Thermal conductivity, Thermal insulators, Steady state one dimensional, heat conduction equation through plane wall, cylindrical wall, spherical wall and composite structure.	25%
4.	Heat transfer equipment, Types of heat exchanger, Shell and tube heat exchanger, Double pipe heat exchanger, Extended surface and Plate type heat exchanger. Evaporators: Batch and continuous type, Capacity of evaporators.	25%

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Industrial Chemistry Vocational programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to ---	
1.	Learn about basic concepts of Fluid machineries and heat transfer equipment..
2.	Apply knowledge in further studies of third year B.Sc. Industrial chemistry Vocational course.

Suggested References:	
Sr. No.	References Books
1.	Introduction to Chemical Engineering, Walter. L. Badger and Juline T. Banchemo (Mcgraw Hill books).
2.	Unit operations of Chemical Engineering, McCabe and Smith, (Mcgraw Hill books).
3.	Unit operations (Volume I & II), (Nirali prakashan, Pune).
4.	Chemical engineering (Volume I & II), J. M. Coulson & K. F. Richardson, (Asian Books Pvt. Ltd, New Delhi)

On-line resources to be used if available as reference material
On-line Resources: Google books, INFLIBNET, Google Web





(Bachelor of Science)(Undergraduate) (Industrial Chemistry Vocational)
B. Sc. (UG) Semester –IV (Effective from JUNE 2022)

Course Code	US04CICV52	Title of the Course	Basic Analytical Chemistry
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Basis of Data Analysis. 2. Concepts of chemical analysis and titration methods.
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Course Content		
Unit	Description	Weightage* (%)
1.	Data Analysis : An analytical data evaluation : Errors, Accuracy and precision, normal distribution curve, Mean and standard deviation, comparison of results (student t-test, f- test) paired t-test, Linear regression and correlation coefficient.	25%
2.	Titrimetric Methods of chemical Analysis, General principle of titrimetry, Types of reaction in titrimetry, Standard solution, Basic requirements of titrimetry, Equivalence point and end point, Aqueous Acid-Base Titration, concept of acid-base titration, Titration curves, Acid-base indicators, Titration Feasibility and its application, Non-aqueous Acid - base Titrations. Role and properties of solvent, Titration in non- aqueous solvents.	25%
3.	Redox Titrations: Introduction, Redox systems, Redox potential, Nernst equation, Equilibrium constant, Titration curve & Feasibility, Redox indicators, Iodometric and iodimetric titrations, Complexometric Titrations: Introduction, Stability constant, Ways of detecting end point, Titration curves, Equilibrium involved in EDTA titration, Types of EDTA titrations, Titration of mixture; Selectivity, Masking and demasking, Metallochromic indicators, Applications.	25%
4.	Precipitation Titrations: Introduction, Feasibility and end point detection, Indicators, Volhard, Fajan and Mohr's methods, Factors affecting solubility of precipitates, Gravimetric Methods of Analysis: Principle of gravimetry, Requirements of precipitates, Formation and properties of precipitates, Coagulation & peptization, Co-	25%





	precipitation and occlusion, Washing, drying and ignition of precipitates.	
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Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Industrial Chemistry Vocational programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to ---	
1.	Learn about basic concepts of Data Analysis, chemical analysis and titration methods.
2.	Apply knowledge in further studies of third year B.Sc. Industrial chemistry Vocational course.

Suggested References:	
Sr. No.	References Books
1.	Analytical Chemistry: Principles-by J. H. Kennedy, Saunders college publishers, 2 nd edition, 1990.
2.	Introduction to Chemical Analysis - by R. D. Braun, Mc-Graw Hill, Book Co. 2 nd edition, 1995.
3	Vogel's Textbook of Quantitative Chemical Analysis- by G. H. Jeffory, J. Mendham, R. C. Denney, 5 th edition, 1998.
4	Analytical Chemistry-by G. D. Christian, Jhon Willey & Sons, 3 rd edition.





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5	Quantitative Analysis - by R. A. Day, Prantice hall of India (P) Ltd., New Delhi, 6 th edition,1993.
6	Modem Analytical Chemistry, By David Harvey, Me Graw-Hill (USA).
7	Principles of Instrumental analysis- by D. A. Skoog & F. J. Holler & T. A. Nieman, Saunders college Publishers, 5 th edition,1998.

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web





(Bachelor of Science)(Undergraduate) (Industrial Chemistry Vocational)
B. Sc. (UG) Semester – IV (Effective from JUNE 2022)

Course Code	US04CICV53	Title of the Course	Practical
Total Credits of the Course	4	Hours per Week	8

Course Objectives:	To make students familiar with: 1. Practical aspects of Fluid machineries and heat transfer. 2. Hands on experience of estimation of metals and organic compounds.
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Course Content	
Practical	Description
I	Experiments based on Fluid moving machineries and Modes of heat transfer. A demonstration of Heat transfer equipment.
II.	Preparation of various solutions, its standardization for the estimation of metals and organic compounds. Experiments based on gravimetric, complexometric Iodometry & Iodimetry methods. Analysis of inorganic substance by semi micro qualitative analysis. pH and conductometric titrations. Experiments based on an applications of Chromatographic techniques.

Teaching-Learning Methodology	Hands on training of Practical's. Courses for B. Sc. Industrial Chemistry Vocational programme are delivered through laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (PowerPoint presentations, audio visual resources, e-resources, seminars, workshops, models).
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Evaluation Pattern		
Sr.No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	---
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	--





3.	University Examination	100%
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Course Outcomes: Having completed this course, the learner will be able to

1.	Learn about Fluid machineries, heat transfer, estimation of metals and organic compounds.
2.	Apply knowledge in further studies of third year B.Sc. Industrial chemistry Vocational course.

Suggested References:

Sr. No.	References Books:
1.	Vogel's Textbook of Quantitative Chemical Analysis, 5 th Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.

On-line resources to be used if available as reference material

On-line Resources: Google books, INFLIBNET, Google Web

