(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester – IV (Effective from June, 2025)

Course Code	**US04MACHE01**	Title of the Course	**ORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Organic chemistry as a subject 2. Application of organic chemistry in development of chemical science as subject. 3. Basic concepts related to stereochemistry, carbohydrates, ultraviolet spectroscopy and, chemical reactivity and molecular structure.

Course Content		
Unit	Description	Weightage* (%)
1.	**STEREOCHEMISTRY** Stereochemistry and stereoisomerism, Optical activity, Conditions of optical activity, Plane-polarized light, Specific rotation, Polarimeter, Production of Enantiomerism, Chirality, the chiral centre, enantiomers, Configuration, Racemic modification, Specification of configuration: R and S, Sequence rules, Diastereomers, Meso structures, Specification of configuration : More than one chiral center, Generation of a chiral center, Synthesis and optical activity, Reaction of chiral molecules: Bond-breaking, Reaction of chiral molecules with optically active reagent, Resolution, Generation of second chiral center, Reaction of chiral molecules Mechanism of free radical chlorination. Free rotation about C-C single bond. Conformation. Torsional strain Conformation of n-butane Vander Waals repulsion, Factors affecting stability of conformation, Conformation of cycloalkanes, Equatorial and axial bond in cyclohexane, Stereoisomerism of cyclic compounds : Cis and trans isomers, Stereoisomerism of cyclic compounds. Conformational analysis.	**25%**
2.	**UV-VISIBLE SPECTROSCOPY** Origin of UV Spectra, Principle of UV-Visible spectroscopy, Application of UV-Visible spectroscopy, Absorption laws (Beer-Lambert's law and its limitation), Types of Electronic transition (σ-σ*, n-σ*, π-π* and n-π*), Cocepts of chromophore and auxochrome, Absorption and intensity shifts (red shift,bathochromicshift, blue shift,hypsochromic shift, hyperchromic effect, hypochromic effect) (with typical examples). Types of absorption bands (K-*, R-*, B- and	**25%**

	E-bands), UV absorption in α,β-unsaturated carbonyl compounds, Effect of conjugation on relative positions of λ_{max} , steric effect and coplanarity, solvent effect, Problems based on Woodward-Fieser rules for calculating λ_{max} in Dienes (polyenes), α,β-unsaturated carbonyl compounds, derivatives of acyl benzene, enones and esters.	
3.	**CARBOHYDRATES- Monosacchrides** Introduction of monosaccharides, Defination and Classification of carbohydrates, (+)–Glucose : an aldohexose, (-)–Fructose : a 2-ketohexose, Stereoisomers of (+)–glucose, Oxidation Effect of alkali,osazone formation, epimerization, Killani Fisher Synthesis, Ruff Degradation, Conversion of an aldose into its epimers, Configuration of aldose , Optical families D and L, Tartaric acid, Families of aldose. Absolute configuration, Cyclic structure of D-(+)-Glucose, Configuration about C–1, Methylation, Determination of ring size. **CARBOHYDRATE–Disaccharides** Disaccharides : (+)–Maltose, (+)–Cellobiose, (+)–Lactose and (+)–Sucrose. Chapter: 34-Problems : 34.17, 2(i).	**25%**
4.	**Unit-IV-A : CARBOXYLIC ACIDS AND DERIVATIVES** Acidity of carboxylic acids, Effect of substituents on acidity, Conversion into acid chlorides, esters, amides, Halogenation of aliphatic acids: Substituted acids, Nucleophilic acyl substitution: Role of carbonyl group, Nucleophilic substitution: Alkyl Vs. Acyl, Alkaline hydrolysis of esters, Acidic hydrolysis of esters,Transesterification, **UNIT : IV-B PHENOLS** Rearrangement of hydroperoxides, Rearrangement of hydroperoxides: Migratory aptitude,Preparation, Reactions, Acidity of phenols, Ester formation, Kolbe reaction: Synthesis of phenolic acids, Reimer-Tiemann reaction, Mechanism of Fries rearrangement and Gatterman synthesis.	**25%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr.	Details of the Evaluation	Weightage

No.		
1.	Internal Written Examination (As per CBCS R.6.8.3), Internal Continuous Assessment in the form of Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3).	50%
2.	University Examination.	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concepts of stereochemistry, ultraviolet spectroscopy, carbohydrates, chemical reactivity and molecular structure.
2.	Apply this knowledge in further studies of third year B.Sc. chemistry course.

Suggested References Books :

Sr. No.	References Books :
1.	A text book of organic chemistry by Arun Bahl and B. S. Bahl, 16th Ed.
2.	Organic chemistry by Morrison and Boyd, 6th Ed.
3.	Organic reaction mechanism by R. K. Bansal, 3rd Ed.
4.	Organic chemistry by S. M. Mukherji, S. P. Singh and R. P. Kapoor. Vol. II.
5.	Applications of Absorption Spectroscopy of Organic Compounds, John R Dyer. Prentice Hall India Learning Private Limited.
6	Elementary Organic Spectroscopy Principles And Chemical Applications, Y R Sharma. S. Chand.

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

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(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester –IV (Effective from June 2025)

Course Code	**US04MACHE02**	Title of the Course	**ANALYTICAL CHEMISTRY-I**
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Analytical chemistry as a subject. 2. Applications of analytical chemistry. 3. Basic concepts related to different kinds of analysis.

Course Content		
Unit	Description	Weightage* (%)
1.	**TITRIMETRIC METHODS IN ANALYSIS** Introduction, Definitions: Standard solutions, Equivalence Point, Indicators, End point, Titration General Aspects of: Primary standards, Desirable properties of standard solution, Volumetric calculations: Molarity, Normality, percentage concentration, parts per million. **Neutralization Titration** Standard solution and acid- base indicators. Titration curve for strong acid-strong base, Systematic equilibrium concentrations for SA-SB titration, Acid-Base indicators, color change range of an indicator, Indicator error, Determination of Acetic acid in vinegar. Determination of Alkalinity of soda ash.	**25%**
2.	**COMPLEXOMETRIC TITRATION** Introduction, terms involved in titration: complex, ligand, buffer solution, chelating agents, chelates, Some Chelating agents, Stability of complexes: stepwise formation constants. Complexometric titration curve, Equilibria involved in EDTA titration, Indicators for EDTA titrations, Hardness of water. 'Ca' in Calcium Gluconate Sample, Numerical based on this titration.	**25%**
3.	**REDOX TITRATION** Introduction, Terms involved: oxidation, reduction. Single electrode potential, formal potential, Nernst Equation, Titration curve for Iron (II) and cerium (IV). Types of redox indicators and their selection. Structural chemistry of redox indicators, Numericals: Calculation	**25%**

	based on emf of electrode/cell, end point calculations, equation constants.	
4.	**WATER POLLUTANTS ANALYSIS** Water pollution: Introduction. Classification of water pollutants, Sources of water pollution, Origin of waste water, Effect of water pollutants, Water analysis: colour, turbidity, total dissolved solids, conductivity, acidity,alkalinity, hardness, chlorides, sulphates, fluorides. Drinking water standards.	**25%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry 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).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3) Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic Titrimetric Methods in Analysis, Neutralization Titration, Complexometric and Redox Titration, Water Pollutants Analysis.
2.	Use this information in further studies of third year B.Sc. chemistry course.

Suggested References:	
Sr. No.	References Books :

1.	Fundamentals of Analytical Chemistry, 7th Edition by skoog, west, Holler.
2.	Quantitative Analysis 6th Edition, R.A. Day, Jr., A.L. Underwood.
3.	Analytical Chemistry –Dr. Alka Gupta, Pragati Prakashan.

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

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(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester –IV (Effective from June, 2025)

Course Code	**US04MACHE03**	Title of the Course	**CHEMISTRY PRACTICAL-1**
Total Credits of the Course	4	Hours per Week	8

Course Objectives:	To make students familiar with: 1. Practical organic chemistry as a subject. 2. Practical aspects of gravimetric analysis. 3. Practical aspects of qualitative analysis of binary organic mixture.

Course Content	
Unit	Description
1.	**Practical-I: BINARY ORGANIC MIXTURE** [Solid + Solid and Solid + Liquid] Only water insoluble (At least Ten) Separation and identification of binary organic mixture : Solid + Solid [A/B/P/N] solid + liquid. Solid Acid : Benzoic Acid, Salicylic Acid, Cinnamic Acid and Phthalic acid. Solid Phenol : (α-napthol, β-napthol) Solid Base : (o, m, and p-nitroaniline, p-toluidine) Solid Neutral : p-dichlorbenzene, naphthalene, anthracene, benzamide, acetanilide, m-dinitrobenzene. Liquids : Methanol, Ethanol, Acetone, methyl/ethyl acetate, $CHCl_3$, CCl_4
2.	**Practical-II : GRAVIMETRIC ANALYSIS** (i) Ba as $BaSO_4$ (ii) Fe as Fe_2O_3 (iii) Al as Al_2O_3 (iv) Ni as $Ni(DMG)_2$ (v) $ZnCO_3$ as ZnO (vi) $BaCl_2.2H_2O$ as $BaCl_2$ (vii) $CuSO_4.5H_2O$ as CuO
3	**VIVA-VOCE exam**

Teaching-Learning Methodology	Hands on training, Practical Courses for B. Sc. Chemistry 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).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage (%)
1.	Continuous and compression evaluation : Laboratory work Assessment 10 (40%), Viva Voce/Lab Quiz 10 (40%), Attendance 05 (20%). [Total 25 Marks (100%)]	50
2.	Semester End Examination : Laboratory work Assessment 20 (80%), Viva Voce/Lab Quiz 5 (20%). (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 25 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about separation and identification of binary organic mixture. As well as Gravimetric analysis. Which will be beneficial them for higher study.
2.	Improve practical skills of students.

Suggested References Books:	
Sr. No.	References Book :
1.	Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.
2.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri
3.	An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra&Nad
4.	Vogel's Textbook of Qualitative organic Analysis By G. Svehla

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

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	Vitthalbhai Patel & Rajratna P. T. Patel Science College (Autonomous) **(Reaccredited with 'A' Grade by NAAC (CGPA 3.13)** **Affiliated to SARDAR PATEL UNIVERSITY** **Vallabh Vidyanagar, Gujarat** **Syllabus effective from the Academic Year 2025-2026**	

(Bachelor of Science)(Undergraduate)

B. Sc. (UG) Semester –IV (Effective from June 2025)

Course Code	**US04MICHE01**	Title of the Course	**ANALYTICAL CHEMISTRY-II**
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make students familiar with: 1. Analytical chemistry as a subject. 2. Applications of analytical chemistry. 3. Basic concepts related to different kinds of analysis.

Course Content		
Unit	Description	Weightage* (%)
1.	**TITRIMETRIC METHODS IN ANALYSIS** Introduction, Definitions: Standard solutions, Equivalence Point, Indicators, End point, Titration General Aspects of: Primary standards, Desirable properties of standard solution, Volumetric calculations: Molarity, Normality, percentage concentration, parts per million. **Neutralization Titration** Standard solution and acid- base indicators, Titration curve for strong acid-strong base, Systematic equilibrium concentrations for SA-SB titration, Acid-Base indicators, color change range of an indicator, Indicator error, Determination of Acetic acid in vinegar, Determination of Alkalinity of soda ash.	**50%**
2.	**WATER POLLUTANTS ANALYSIS** Water pollution: Introduction. Classification of water pollutants, Sources of water pollution. Origin of waste water, Effect of water pollutants, Water analysis: colour, turbidity, total dissolved solids, conductivity, acidity,alkalinity, hardness, chlorides, sulphates, fluorides. Drinking water standards.	**50%**

Teaching-Learning	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom,

Methodology	laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R.6.8.3), Internal Continuous Assessment in the form of Practical journal, Viva-voce exam, Attendance (As per CBCS R.6.8.3).	50%
2.	University Examination.	50%

Course Outcomes: Having completed this course, the learner will be able to :	
1.	Learn about basic Titrimetric Methods in Analysis, Water Pollutants Analysis.
2.	Use this information in further studies of third year B.Sc. chemistry course.

Suggested References Books:	
Sr. No.	References Books:
1.	Fundamentals of Analytical Chemistry, 7th Edition by skoog, west, Holler.
2.	Quantitative Analysis 6th Edition, R.A. Day, Jr., A.L. Underwood.
3.	Analytical Chemistry –Dr. Alka Gupta, Pragati Prakashan.

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

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(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester –IV (Effective from June 2025)

Course Code	**US04MICHE02**	Title of the Course	**CHEMISTRY PRACTICAL-2**
Total Credits of the Course	2	Hours per Week	4

Course Objectives:	To make students familiar with: 1. Practical organic chemistry as a subject. 2. Practical aspects of qualitative analysis of binary organic mixture.

Course Content	
Pactical	Description
1.	**BINARY ORGANIC MIXTURE** [Solid + Solid] Only water insoluble (At least Ten) Separation and identification of binary organic mixture : Solid + Solid [A/B/P/N] Solid Acid : Benzoic Acid, Salicylic Acid And Cinnamic Acid Solid Phenol : (α-napthol, β-napthol) Solid Base : (o-, m-, and p-nitroaniline) Solid Neutral : p-dichlorbenzene, naphthalene, anthracene, benzamide, acetanilide, m- dinitrobenzene.
2	**Viva-voce exam**

Teaching-Learning Methodology	Hands on training, Practical Courses for B. Sc. Chemistry 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).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Continuous and compression evaluation : Laboratory work Assessment	50

	10 (40%), Viva Voce/Lab Quiz 10 (40%), Attendance 05 (20%). [Total 25 Marks (100%)]	
2.	Semester End Examination : Laboratory work Assessment 20 (80%), Viva Voce/Lab Quiz 5 (20%). (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 25 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about separation and identification of binary organic mixture. As well as Gravimetric analysis, which will be beneficial them for higher study.
2.	Improve practical skills of students.

Suggested References Books:	
Sr. No.	References Books:
1.	Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition By G. H. Jeffery, J.Basset, J.Mendham, R.C.Denney.
2.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S.Giri.
3.	An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad.
4.	Vogel's Textbook Of Qualitative organic Analysis By G. Svehla.

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

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(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester – IV (Effective from June 2025)

Course Code	**US04SECHE01**	Title of the Course	**SOIL ANALYSIS PRACTICAL**
Total Credits of the Course	2	Hours per Week	4

Course Objectives:	To make students familiar with: 1. To develop the skills of analysis. 2. Practical aspects of chemical analysis of soil.

Course Content	
Practical	Description
1	Introduction of Chemical and Instrumental methods of analysis. Importance of soil analysis in agriculture. 1. Method for soil sampling. 2. To determine the Moisture content of given soil sample. 3. To determine the Water Holding Capacity (WHC) of given soil sample. 4. To determine the Soil Texture content of given soil sample. 5. To determine the pH of given soil sample 6. To determine the Lime Requirement of given soil sample by Woodruff's Method (Woodruff, 1948) 7. To determine Electrical Conductivity (EC) of given soil sample. 8. To determine Organic Carbon/Organic Matter of given soil sample. 9. To determine Total Nitrogen (Kjeldahl Method) of given soil sample. 10. To determine Available Phosphorus of given soil sample. 11. Determination of exchangeable Calcium and Magnesium of given soil sample.
2	**Viva-voce exam**

Teaching-Learning Methodology	Hands on training, Practical Courses for B. Sc. Chemistry programme are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr.	Details of the Evaluation	Weightage

No.		(%)
1.	Continuous and compression evaluation : Laboratory work Assessment 10 (40%), Viva Voce/Lab Quiz 10 (40%), Attendance 05 (20%). [Total 25 Marks (100%)]	50
2.	Semester End Examination : Laboratory work Assessment 20 (80%), Viva Voce/Lab Quiz 5 (20%). (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 25 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	Develop the skill of analysis of soil along with knowledge of chemical and instrumental analysis. This will be beneficial them for ready to join as a quality control chemist.
2.	Improve practical skills of students.

Suggested References Books:	
Sr. No.	References Books
1.	Instrumental Method of Chemical Analysis, by B K Sharma, 2014, ISBN: 978-81-8283-673-0, Goel Publishing House.
2.	Soil Analysis Handbook of Reference Methods, by J. Benton Jones Jr. (Editor) ISBN-13: 978-0849302053.
3.	Hand Book of Water, Air and Soil Analysis by Anand Dev Gupta, International E – Publication.
4.	Vogel's Textbook of Quantitative Chemical Analysis –Vth Edition, by G H Jeffery, J Bassett, R C Denney, Longman Sci. & Tech. Publication.

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

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	Vitthalbhai Patel & Rajratna P. T. Patel Science College (Autonomous) **(Reaccredited with 'A' Grade by NAAC (CGPA 3.13)** **Affiliated to SARDAR PATEL UNIVERSITY** **Vallabh Vidyanagar, Gujarat** **Syllabus effective from the Academic Year 2025-2026**	

(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester – III (Effective from June, 2025)

Course Code	**US04SECHE02**	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make students familiar with: 1. Physical chemistry as an individual subject. 2. Application of Physical chemistry in biological science. 3. Basic concepts related to Chemistry of acids and bases,colloids,stoichiometry and reaction rates.

Course Content		
Unit	Description	Weightage* (%)
1.	**[A] VOLUMETRIC ANALYSIS** Introduction of volumetric analysis,classification of reaction in volumetric analysis, standard solutions, types of volumetric analysis methods,(i) Neutralization titration (ii) Complexometric titration (iii) Redox titration (iv) Precipitation titration. **[B] COLLOIDS, VISCOSITY , SURFACE TENSION, OSMOSIS, DIFFUSION : MEMBRANE EQUILIBRIUM:** Colloid definition and classification of Colloids, Properties of Colloids-Brownian movement, Tyndall effect, Dialysis, Ageing, Coagulation, Electrical properties, Biologiccal significance of colloids. Definition and significance of viscosity, Surface Tension, Osmosis, Diffusion : Membrane equilibrium:	**50%**
2.	**CHEMICAL REACTIONS AND STOICHIOMETRY** Understanding reaction rates and kinetics, including factors affecting reaction rates and different types of reactions, reaction rate, Rate law and reaction orders , Arrhenius equation. Balancing chemical equations, Stoichiometric calcutions, Calculating stoichiometric quantities, Types of chemical reactions, Molar mass and Avogadro's number.	**50%**

Teaching-Learning Methodology	Conventional method (classroom blackboard teaching), ICT. Courses for B. Sc. Chemistry programme are delivered through classroom,

	laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools (Power Point presentations, audio visual resources, e-resources, seminars, workshops, models).

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage (%)
1.	Internal Written Examination (As per CBCS R.6.8.3), Internal Continuous Assessment in the form of Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3).	50
2.	University Examination.	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concepts related to Chemistry and application in biological fields.
2.	Apply knowledge in further studies of B.Sc. course.

Suggested References Books:	
Sr. No.	References Books
1.	Fundamentals of Analytical Chemistry, 7th Edition by skoog, west, Holler.
2.	Quantitative Analysis 6th Edition, R.A. Day, Jr., A.L. Underwood.
3.	University Chemistry By Mahan, B. H. 3rd Ed. Narosa.
On-line resources to be used if available as reference material	
On-line Resources: Google books, INFLIBNET, Google Web	

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