(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester -V

Course Code	**US05MACHE01**	Title of the Course	**ORGANIC CHEMISTRY-I**
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To make students familiar with: 1. Organic Chemistry as a subject. 2. Advanced topics of organic chemistry and spectroscopy. 3. Understanding of heterocyclic compounds, reaction mechanism and Spectroscopy.

Course Content		
Unit	Description	Weightage* (%)
1.	**HETEROCYCLIC COMPOUNDS** Heterocyclic systems, Structure of Pyrole, furan and thiophene, Source of Pyrole, furan and thiophene, Electriphilic substitution in Pyrrole, furan and thiophene Reactivity and orientation, Saturated five – membered heterocycle, Structure of pyridine, Sources of pyridine compounds, Reactions of pyridine, Electrophilic substitution in pyridine, Nucleophilic substitution in pyridine, Basicity of pyridine, Reduction of pyridine, Quinoline. The skraup synthesis of Quinoline, The Bischler–Napieralski synthesis of Isoquinoline. Knorr pyrrole synthesis**.**	**25%**
2.	**REACTION MECHANISM** Baeyer-Villiger oxidation, Hofmann rearrangement, Mannich reaction, Curtius–Schmidt rearrangement, Benzilic acid rearrangement, Sommlet rearrangement, Birch reduction, Favorskii rearrangement, Benzoin condensation, Beckmann rearrangement, Wittig reaction, Perkin reaction.	**25%**

3.	**INFRARED SPECTROSCOPY** Introduction, principle of IR spectroscopy, instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies. Differentiate two compounds by the IR frequencies. Problems pertaining to the structure elucidation of organic compounds using IR.	**25%**
4.	**NMR SPECTROSCOPY** The nuclear magnetic resonance (NMR) spectrum. Number of signals, NMR positions of signals. Chemical shift, NMR peak area and proton counting, NMR Splitting of signals. Spin-spin coupling, NMR coupling constant, Problems based on above spectroscopic techniques.	**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. No.	Details of the Evaluation	Weightage (%)
1.	Internal Continuous Assessment in the form of Class test/Internal Written test 15 Marks (30%), Quiz 15 Marks (30%) Active learning 05 Marks (10%), Home Assignments 05 Marks (10%), Class Assignments 05 Marks (10%), Attendance 05 Marks (10%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 50 Marks (100%)].	50
2.	Semester End Examination [Total 50 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to learn	
1.	About basic concept of heterocyclic compounds, reaction mechanism and IR & NMR

	spectroscopy.
2.	Aplication in further higher studies and in industries.

Suggested References Books:	
Sr. No.	References
1.	Organic chemistry of natural products by Gurdeep Chatwal, Vol.II.
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.	Synthetic organic chemistry by Gurdeep R. Chatwal
6.	Organic chemistry, Vol II, by I.L.Finar.
7.	Principles of Organic synthesis, by ROC Norman.
8.	Heterocyclic chemistry vol.II by R. R. Gupta, M. Kumar and V. Gupta
9	Organic Spectroscopy by P. S. Kalsi 3. Organic Spectroscopy by J R Dyer.
10	Elementary Spectroscopy by Y R Sharma
11	Introduction to Spectroscopy: Donald L. Pavia, Gary M. Lampman, George S.Kriz Cengage Learning; 4th Edition.
12	Applications of spectroscopic techniques in Organic Chemistry: P.S. Kalsi, New Age International; 6th Edition.

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

*****

(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester - V

Course Code	**US05MACHE02**	Title of the Course	**ANALYTICAL CHEMISTRY**
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To make students familiar with: 1. Analytical Chemistry as a subject. 2. Advanced topics of analytical chemistry. 3. Understanding methods of analysis and chromatography.

Course Content		
Unit	Description	Weightage* (%)
1.	**pH-METRY:** Introduction, types of indicator electrodes and reference electrodes, types of titrations. **POTENTIOMETRY:** Introduction, types of titrations, graphical method for end point determination. **CONDUCTIMETRY:** Introduction, types of conductance, effect of dilution, conductivity cells, types of titration.	**25%**
2.	**CHROMATOGRAPHY – I** Introduction, classification, paper chromatography, thin layer chromatography, column chromatography, ion-exchange chromatography, experimental details for all the techniques.	**25%**
3.	**CHROMATOGRAPHY-II** **GAS CHROMATOGRAPHY** Introduction, Technique of Gas Liquid Chromatography, Apparatus of Gas Liquid Chromatography (Carrier Gas, Injection Port, Columns, The solid inert support, The stationary liquid phase), Detectors, Thermal Conductivity Detectors, Flame Ionization Detectors, Electron Capture Detectors. **HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)** Introduction, Principle and Apparatus of HPLC (Solvent delivery system, Pumps, Sample Injection System, Columns, Column Packing materials, Column packing), Choice of supporting materials for	**25%**

	separation, Detectors.	
4.	**SOLVENT EXTRACTION METHODS:** The Distribution Law, Extraction process, Liquid liquid extraction, Factor affecting Extraction, Technique for Solvent Extraction, Quantitative treatment of solvent Extraction eqillibria, Classification of Solvent Extraction system, Types of extraction system, Advantage of Solvent Extraction system, Application of Liquid extraction, Solvent extraction methods in Metallurgy, Solid-Liquid Extraction	**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. No.	Details of the Evaluation	Weightage (%)
1.	Internal Continuous Assessment in the form of Class test/Internal Written test 15 Marks (30%), Quiz 15 Marks (30%) Active learning 05 Marks (10%), Home Assignments 05 Marks (10%), Class Assignments 05 Marks (10%), Attendance 05 Marks (10%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 50 Marks (100%)].	50
2.	Semester End Examination [Total 50 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	From the study of this paper, student will learn about basic concept of analytical techniques like pH metry, Potentiometry and Conductometry, solvent extraction and chromatography.
2.	This study will helpful them in further studies and in industries.

Suggested References Books:	
Sr. No.	References Books:
1.	Instrumental methods of Chemical Analysis by B. K. Sharma
2.	Instrumental methods of Chemical Analysis by Gurdeep R Chatwal
3.	Quantitative Analysis by Skoog & West

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

*****

(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester -V

Course Code	**US05MACHE03**	Title of the Course	**CHEMISTRY PRACTICAL**
Total Credits of the Course	04	Hours per Week	08

Course Objectives:	To make students familiar with: 1. Practical chemistry as a subject 2. Practical aspects of physical, organic, inorganic and analytical chemistry. 3. Advanced practical aspects of different branches of chemistry.

Course Content	**Total Marks : 100**
Unit	Description
Practical -I	**Title Of Subject : ORGANIC CHEMISTRY PRACTICAL (SIX TYPES AND 2 LIQUID MIX.)** Separation and Identification of two component organic mixture using chemical and physical methods (water soluble, insoluble & liquid + liquid) **Solid Acid**: Benzoic acid, salicylic acid, cinnamic acid, phthalic acid , succinic acid, oxalic acid. **Solid phenol**:- α- naphthol, β-naphthol, resorcinol. **Solid neutrals**:- p-dichlorobenzene, naphthalene, anthracene, benzamide, urea, thiourea, acetanilide, m-dinitrobenzene. **Solid Base**:- o-, m- & p-nitroaniline, p-toluidene, **Liqui d base**:- aniline, **Liquid neutral**:- ethyl acetate, methyl acetate, acetone, methyl alcohol, ethylalcohol, benzaldehyde, chlorbenzene, nitrobenzene, $CHCl_3$, acetohpenone **(Derivative of any one out of two compounds)** **VIVA EXAMINATION**
Practical -II	**Title Of Subject : ANANLYTICAL CHEMISTRY PRACTICAL** **1. Gravimetric Analysis (Mixture with interfering radicals like removal of Cu) [Any one experiment can be asked in University Exam]** 1. Ba as $BaSO_4$ 2. Al as Al_2O_3 3. Mn as $Mn_2P_2O_7$ 4. Zn as $Zn_2P_2O_7$ **2. Volumetric Analysis by self preparation of EDTA**

	1. Estimation of Bi^{3+} by EDTA. 2. Estimation of Ni^{2+} by EDTA. 3. Estimation of Chloride by silver nitrate (Mohr's Method). 4. Estimation of Fe^{3+} by EDTA (Back Titration). **VIVA EXAMINATION**

Teaching-Learning Methodology	Hands on training of Practicals and Instruments. 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 Continuous Assessment in the form of Labwork assessment 20 Marks (40%), lab quiz/viva voce 20 Marks (40%) and attendance 10 Marks (20%). [Total 50 Marks (100%)].	50
2.	Semester End Examination Labwork assessment 40 Marks (80%), lab quiz/viva voce 10 Marks (20%) . [Total 50 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn performing chemical experiments using qualitative and quantitative methods for qualitative method to separate organic mixture in to its constituents and gravimetric as well as complexometric titrations.
2.	Apply in further studies and in industries.

References Books:	
Sr. No.	**References Books**

1.	Experimental Physical Chemistry by R. C. Das & B. Behera
2.	Advanced Physical Chemistry by J. B. Yadav
3.	Comprehensive practical organic chemistry Preparation and qualitative analysis by V. K. Ahuwalia and Renu Agarwal.
4.	Organic Preparation by A. I. Vogel
5.	Vogel's Text book of Quantitative Chemical Analysis, 5th Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.
6.	Vogel's Textbook Of Qualitative Inorganic Analysis By G. Svehla
7.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri
8.	An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad

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

*****

SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.11)
(Effect from : 2025-26)

(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester - V

Course Code	**US05MICHE01**	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	02	Hours per Week	02

Course Objectives:	To make students familiar about: 1. Inorganic Chemistry as a subject. 2. Advanced topics of Inorganic chemistry. 3. Understanding of chemistry of organo metallic compounds and principles of metallurgy.

Course Content		
Unit	Description	Weightage* (%)
1.	**(A) ORGANO METALLIC CHEMISTRY:** Introduction, General methods of preparations, General properties, Organo metallic compounds of alkali metals, Organo metallic compounds of beryllium, Organo metallic compounds of magnesium, Organo metallic compounds of aluminium, Metal olefin (alkenes) complexes **(B) CYCLOPENTADIENYL COMPLEXES:** Preparation of metallocenes and their derivatives, Some properties of ferrocene molecule, Structure and bonding in ferrocene molecule, Ionic cyclopentadienyl compounds.	**50%**
2.	**PRINCIPLES OF METALLURGY AND CHEMISTRY OF Pb, Fe, & Cu:** Metals, Occurrence of metals, Mineral wealth of India, Metallurgy, Concentration and ore, Calcinations and roasting, Standard electrode potentials and metallurgy, Thermodynamics of metallurgy, Reducing behaviour of carbon, Reduction of mineral to metal, Refining of metals, Physical methods of refining, Chemical methods of refining, Types of furnaces used, Pb: occurrence & extraction, properties & uses of lead, white lead, Fe: occurrence and commercial forms of ion, manufacture of cast iron & steel, Cu: occurrence & extraction electrolytic refining of copper, properties and uses of copper.	**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.	Continuous and compression evaluation: Class test/Internal written test 10 Marks (40%), Quiz 05 Marks (20%), Home Assignments 05 Marks (20%), Attendance 05 Marks (20%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 25 Marks (100%)].	50
2.	Semester End Examination [Total 25 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concepts of organo metallic compounds and metallurgy.
2.	Know the basics to enable student in further studies and prepare for role in industries.

Suggested References Books:	
Sr. No.	References Books:
1.	Textbook of Inorganic Chemistry -20thedition, Chapter-13 By P. L. Soni & Mohan Katyal
2.	Advanced Inorganic Chemistry Volume II By Satya Prakash, G. D. Tuli, S. K. Basu, R. D. Madan
3.	CONCISE INORGANICCHEMISTRY : 5TH EDITION BY: J.D.LEE
4.	Basic Inorganic Chemistry- 3rd Edition By F. Albert Cotton, Geoffery Wilkinson & Paul L. Gaus

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

*****

(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester - V

Course Code	**US05MICHE02**	Title of the Course	**INORGANIC QUANTITATIVE ANALYSIS PRACTICAL**
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	To make students familiar about: 1. Inorganic Chemistry practical as a subject. 2. Redox and acid-base estimations. 3. Practical aspects of chemistry 4. Basic concepts related to volumetric analysis. 5. Hands on training of laboratory practices.

Practical	Description
Practical	Volumetric analysis : Neutralization Titrations : (For the following exercise student has to prepare solution of titrant) (i) Standardization of NaOH using Succinic acid. (ii) Standardization of HCl using NaOH solution. (iii) Titration of Oxalic Acid → NaOH (iv) Titration of Succinic acid → KOH (v) Titration of Oxalic Acid → KOH TITRIMETRIC ANALYSIS (REDOX TITRATION) (vi) Titration of $KMnO_4$ → $FeSO_4(NH4)_2.SO_4$ .6 H_2O (vii) Titration of $K_2Cr_2O_7$ → $FeSO_4$ .7H_2O using internal indicator diphenylamine sulphate. (viii) Titration of $KMnO_4$ → Oxalic acid (ix) Titration of $KMnO_4$ → $FeSO_4.7H_2O$

Teaching-Learning Methodology	Hands on training to Practical Courses are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage (%)
1.	Continuous and compression evaluation: Class test/Internal written test 10 Marks (40%), Quiz 05 Marks (20%), Home Assignments 05 Marks (20%), Attendance 05 Marks (20%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 25 Marks (100%)].	50
2.	Semester End Examination [Total 25 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about hands on training of Volumetric analysis.
2.	Improve practical skills of students.

Suggested References Book:	
Sr. No.	References Books:
1.	Mendham, J., Denney, R. C., Barnes, J. D., Thomas, M. J. K., Vogel's textbook of quantitative chemical analysis, 6th Edition.
2.	Pandey, O. P., Bajpai, D. N., Giri, S., Practical Chemistry.
3.	Ghoshal, Mahapatra, Nad , An Advanced course in Practical Chemistry.

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

*****

(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester - V

Course Code	**US05MICHE03**	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	02	Hours per Week	02

Course Objectives:	To make students familiar about: 1. Physical Chemistry topics like photochemistry and colloidal state. 2. Understanding of significance of photochemistry.

Course Content		
Unit	Description	Weightage* (%)
1.	**PHOTOCHEMISTRY:** Introduction, Types of chemical reactions, Difference between Dark and Photochemical reaction, Absorption of light, Laws of photochemistry, Quantum yield (or) Quantum efficiency, Deviation in the law of photochemical equivalence, Reasons of high and low quantum yield, Factors affecting quantum yield, Luminescence, Fluroescence and Phosphorescence, Numerical	**50%**
2.	**COLLOIDAL STATE:** Types of Colloidal system, Classifications of Colloids, Lyophobic and Lyophilic Sols, Size range, Preparation and Properties of colloids solution, Dialysis, Electro dialysis, Ultra filtration, Electrical Double Layer, Electrophoresis, Electro osmosis, Importance and Applications of Colloids, Numerical.	**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.	Continuous and compression evaluation : Class test/Internal written test 10 Marks (40%), Quiz 05 Marks (20%), Home Assignments 05 Marks (20%), Attendance 05 Marks (20%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 25 Marks (100%)].	50
2.	Semester End Examination [Total 25 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn about basic concepts of photochemistry and colloidal states.
2.	Know the basics to enable student in further studies and prepare for role in industries.

Suggested References Books::	
Sr. No.	References Books:
1.	Advanced Physical Chemistry by Gurdeep Raj.
2.	Text book of physical chemistry by Samuel Glasstone.
3.	Principles of Physical Chemistry by Puri, Sharma and Pathania. 38th Edition.
4.	Essential of physical chemistry by Bahl, Bahl and Tuli. 25th edition.
5.	Physical Chemistry by G. M. Barrow, 5th ed.
6.	Textbook of physical chemistry by P.L. Soni, O.P. Dharmarha, U. N. Dash
7.	University chemistry by Bruce H Mahan
8.	Principles of Physical chemistry, S H Marron, Karl F prutton

9.	Physical Chemistry, Ira Levine
10.	Physical Chemistry, Atkins
11.	Principles of polymers Science by P. Bahadur and N. V. Sastry (2nd Edition)
12.	Polymer Science by V. R. Gowariker, N. V. Vashwanathan and Jaydev Shreedhar.

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

*****

(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester - V

Course Code	**US05MICHE04**	Title of the Course	**Chemistry Practical**
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	To make students familiar with: 1. Practical aspects of inorganic chemistry. 2. Hands on experience of inorganic volumetric titration. 3. Basic concepts related to practical inorganic chemistry.

Practical	Description
Practical	Volumetric Titration (By self-preparation of solution of titrant): (i) Determination of total hardness of water sample. (ii) Determination of Ni^{2+} by back titration. (iii) Determination of NO_2^{-1} by back titration. (iv) Estimation of Fe^{3+} by EDTA (Back Titration). (v) Estimation of Bi^{3+} by EDTA. (vi) Estimation of Cu^{2+} by EDTA. (vii) Estimation of Aniline (viii) Estimation of Phenol Viva-Voce Exam

Teaching-Learning Methodology	Hands on training of Practicals: Chemistry practicals are delivered through classroom, laboratory work in a challenging, engaging, and inclusive manner that accommodates a variety of learning styles and tools.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage (%)
1.	Continuous and compression evaluation: Class test/Internal written test 10 Marks (40%), Quiz 05 Marks (20%), Home Assignments 05 Marks (20%), Attendance 05 Marks (20%), (As per SPU Letter No. E-3/2748	50

	dated 02/02/2024) [Total 25 Marks (100%)].	
2.	Semester End Examination [Total 25 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	From the study of this course, students will learn about hands on training of volumetric analysis.
2.	This study will be helpful in further studies and in industries.

Suggested References:	
Sr. No.	References
1.	Vogel's Text book of Quantitative Chemical Analysis, 5th Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.
2.	Vogel's Textbook Of Qualitative Inorganic Analysis By G. Svehla
3.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri

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

*****

Bachelor of Science – Undergraduate - Chemistry
B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code (Minor)	**US05MICHE05**	**Title of the Course**	**Petrochemicals**
Total Credits of the Course	**2**	**Hours per Week**	**2**

Course Objectives:	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 chemicals entities derived from petroleum source. Also, they will learn the analytical aspects of petroleum new material, fuels and products derived thereof.

Course Content		
Unit	Description	Weightage*(%)
1.	Introduction, Sources and deposits of world, Various Indian Petroleum industries, Purification (refining and rectification) process of petroleum, Cracking and Reforming process for the petroleum, various reaction occurs during cracking of petroleum fractions. Light petroleum products, their specifications and test methods, chemicals derived from C1, C2, C3 and C4-Fraction, Separation of components of Petroleum.	50%
2.	Manufacture of following compound form petroleum fractions: HCN, CS_2, Maleic anhydride, Caprolactum, Phthalic anhydride, Ethyl Benzene, Isopropylbenzene, Butadiene, Vinyl acetate, Acetaldehyde, Ethanol, Ethylene oxide, Phenol, Propionaldehyde, Benzene sulphonic acid.	50%

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

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal (Written Examination, Continuous Evaluation, Quizzes, Seminars, Assignments, Attendance) (As per NEP – 2020)	50%

2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	This paper will inculcate knowledge of petroleum industry.
2.	The students will study the sources of petroleum products, separation and purification, types of petroleum products and the chemistry of petroleum process.
3.	Also, they will learn about types of products obtained from petroleum fractions.

Suggested References:	
Sr. No.	References
1.	Modern petroleum refining processes vth addition., B.K. Bhaskara
2.	A text on Petrochemicals by Bhaskar Rao (Khanna Publishers-New Delhi)
3.	Modern Petroleum Refining process By Bhaskar Rao (Oxford & IBH Publishing Co, Pvt.Ltd.-New Delhi).
4.	Advanced Petrochemicals By Dr. G.N. Sarkar (Khanna Publishers).
5.	Advanced Petroleum Refining By Dr. G.N. Sarkar (Khanna Publishers).
6.	Chemicals from Petroleum by A.L. Waddam (ELBS edition, London).
7.	Shreve's Chemical Process Industries By Austin (Mac Grow-Hill Publiction, New Delhi).
8.	Riegel's Hand Book of Industrial Chemistry by James A Kent (CBS Publishers & Distributors-New Delhi).

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

*****

Bachelor of Science - Undergraduate - Chemistry
B. Sc. (UG) Semester – V(Effective from JUNE 2025)

Course Code (Minor)	**US05MICHE06**	**Title of the Course**	**Petrochemicals– Practical**
Total Credits of the Course	**02**	**Hours per Week**	**04**

Course Objectives:	This paper will Develop the skill of students towards various petroleum products (as per the ASTM testing Procedure). Moreover, it will help to help to develop the skill towards preparation and purification of various in petrochemicals.

Course Content
Testing of Petroleum and Petroleum products according to ASTM for: Kinematic viscosity by Redwood viscometer and Say bolt Viscometer, Open cup Flash & Fire point determination, Distillation characteristics, Cloud & Pour Point determination, Aniline Point and Mixed Aniline Point, Carbon Residue by Ram's Bottle and calradon's method, % moisture determination Dean & Stark method, consistency of wax and grease determination by cone and needle penetration method and congealing point determination.

Teaching-Learning Methodology	Courses for B. Sc. Industrial Chemistry program 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 (Practical Examination, Viva – Voce) (As per NEP – 2020)	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to Acquire practical knowledge of basic petroleum laboratory tools which are used in petroleum industry and purification for the subject of industrial chemistry.

Bachelor of Science - Undergraduate - Chemistry
B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code (Minor)	**US05MICHE07**	Title of the Course	**Chemical Process Industries**
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make students familiar with: 1. A comprehensive understanding of the manufacturing processes and properties of nitrogenous products. 2. Knowledge of electrothermal industries and fundamental principles of electrochemical industries.

Course Content		
Unit	Description	Weightage*(%)
1.	Nitrogenous Products: Manufacturing processes and properties of synthetic nitrogen-based products, Study of ammonia and various nitrogenous fertilizers, including, Urea, Ammonium sulfate, Ammonium nitrate, Calcium ammonium nitrate, Industrial applications and environmental considerations.	**50%**
2.	Electrothermal Industries: Introduction, classification, applications, and economic considerations of industrial furnaces, Manufacturing processes of: Silicon carbide, Calcium carbide, Boron carbide, Boron nitride, Synthetic graphite, Carbon electrodes. Electrochemical Industries: Production and industrial significance of Magnesium and its compounds (Mg anhydrous, $MgCl_2$, MgO), Hydrogen peroxide, Potassium permanganate, Hydroxylamine.	**50%**

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

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal (Written Examination, Practical Examination, Continuous Evaluation, Quizzes, Seminars, Assignments, Attendance) (As per NEP – 2020)	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Demonstrate knowledge of the synthesis, properties, and industrial applications of synthetic nitrogen products, including ammonia, urea, ammonium sulfate, ammonium nitrate, and calcium ammonium nitrate.
2.	Understand the fundamentals of electrothermal processes, including the operation, uses, and economics of industrial furnaces.

Suggested References:	
Sr. No.	References
1.	B. K. Sharma, "Industrial Chemistry," Goel Publishing House.
2.	G. T. Austin, "Shreve's Chemical Process Industries," McGraw-Hill.
3.	V. Sauchelli, "Chemistry and Technology of Fertilizers," Reinhold Publishing Corporation.
4.	C. A. Schacht, "Handbook of Industrial Furnaces and Kilns," CRC Press.
5.	T. F. Fuller and J. N. Harb, "Electrochemical Engineering," Wiley.
6.	F. Habashi, "Principles of Extractive Metallurgy," CRC Press (For electrothermal and electrochemical industries).
7.	L. L. Henke, "Industrial Chemical Process Design," McGraw-Hill.

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

*****

Bachelor of Science - Undergraduate - Chemistry
B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code (Minor)	**US05MICHE08**	Title of the Course	**Chemical Process Industries – Practical**
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	This course aims to: 1. Develop students' practical skills in the synthesis, purification, and characterization of fine and heavy inorganic chemicals. 2. Provide hands-on experience in industrial processes, including catalyst preparation and solvent extraction. 3. Familiarize students with performance evaluation techniques for industrial coatings and other chemical products.

Course Content
Preparation, purification, and estimation of fine and heavy inorganic chemicals: Tetra-amine copper (II) sulfate, Tetra-thiourea copper(I) sulfate, Sodium thiosulfate, Hexa-thiourea lead nitrate, Chrome Red, Magnesium hydroxide, Magnesium carbonate, Magnesium trisilicate, Magnesium stearate, Zinc stearate Preparation of industrial metal-supported catalysts: Synthesis and characterization of heterogeneous catalysts, Study of catalytic efficiency and applications. Extraction and purification of industrial solvents: Techniques for solvent separation and refinement, Quality assessment of purified solvents.

Teaching-Learning Methodology	Courses for B. Sc. Industrial Chemistry program 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 (Practical Examination, Viva – Voce) (As per NEP – 2020)	50%
2.	University Examination	50%

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Demonstrate proficiency in the synthesis and purification of fine and heavy inorganic chemicals.
2. Understand the principles of catalyst preparation and solvent extraction in industrial applications.
3. Analyze and evaluate the performance of industrial coatings based on physical and chemical parameters.
4. Develop practical problem-solving skills applicable to chemical industries.

Suggested References:	
Sr. No.	References
1.	Vogel's Textbook of Practical Inorganic Chemistry by G. Svehla, A. I. Vogel – Pearson.
2.	Industrial Inorganic Chemistry by Karl-Heinz Büchel, Hans-Heinrich Moretto, and Peter Woditsch – Wiley-VCH.
3.	Catalysis: Principles and Applications by B. Viswanathan and S. Sivasanker – Narosa Publishing.
4.	Solvent Extraction Principles and Practice by Jan Rydberg, Claude Musikas, and Gregory R. Choppin – CRC Press.
5.	Industrial Coatings: Applications and Chemistry by E. W. Flick – William Andrew Publishing.
6	Handbook of Industrial Chemistry and Biotechnology by James A. Kent – Springer.

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

*****

Bachelor of Science - Undergraduate - Chemistry
B. Sc. (UG) Semester – V(Effective from JUNE 2025)

Course Code (Minor)	**US05MICHE09**	Title of the Course	**Industrial Management & Economics – I**
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make students familiar with: 1. Developing an understanding of various business ownership models and key entrepreneurial skills essential for launching and managing enterprises. 2. Enhancing marketing insights, decision-making capabilities, and financial acumen for effective business management.

Course Content		
Unit	Description	Weightage*(%)
1.	Forms of Business Ownership:Sole Proprietorship: Features, advantages, and disadvantages, Partnership: Characteristics, benefits, and challenges, Co-operative Societies: Role, structure, and significance in business, Joint Hindu Family Business: Structure and relevance in the Indian context, Joint Stock Companies: Formation, characteristics, and legal framework. Entrepreneurship and Enterprise Development:Entrepreneurial decision-making process, Stages of launching a new enterprise, Principles of management and their application in business growth.	**50%**
2.	Financial Management:Sources of finance (equity, debt, venture capital, government schemes, etc.), Working capital vs. fixed capital management, Concepts of interest, depreciation, taxation, and insurance in business finance. Marketing Management:Core concepts of marketing, market segmentation, and targeting, Pricing policy and factors influencing pricing decisions, Break-even analysis and its significance in profitability assessment.	**50%**

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

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal (Written Examination, Practical Examination, Continuous Evaluation, Quizzes, Seminars, Assignments, Attendance) (As per NEP – 2020)	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Analyze various business ownership structures and their legal and financial implications.
2.	Make informed entrepreneurial decisions by understanding business setup, management principles, and growth strategies.
3.	Develop financial literacy, including capital management, cost analysis, and taxation policies.
4.	Apply marketing principles, pricing strategies, and profitability assessments to real-world business scenarios.

Suggested References:	
Sr. No.	References
1.	C.B. Gupta – "Business Organization and Management"
2.	M.C. Shukla – "Business Organization and Management"
3.	Donald F. Kuratko – "Entrepreneurship: Theory, Process, Practice"
4.	Poornima M. Charantimath – "Entrepreneurship Development and Small Business Enterprises"
5.	T. Ramasamy – "Principles of Management"
6.	Prasanna Chandra – "Financial Management: Theory and Practice"
7.	Philip Kotler, Kevin Lane Keller – "Marketing Management"
8.	Charles T. Horngren, Srikant M. Datar, Madhav V. Rajan – "Cost Accounting: A Managerial Emphasis"

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

*****

Bachelor of Science - Undergraduate - Chemistry
B. Sc. (UG) Semester – V(Effective from JUNE 2025)

Course Code (Minor)	**US05MICHE10**	Title of the Course	**Industrial Management & Economics – I – Project Work**
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	This course aims to develop students' leadership and management skills in industrial settings, with a particular focus on the chemical industry. It enhances their understanding of business organization, financial planning, and industrial operations.

Course Content
Book Review Report Writing: Preparation, submission, and presentation of a book review related to business management or industrial operations. Case Study Analysis: Conducting a case study on a selected management area within the chemical industry, preferably based on an industrial visit. Project Work: Students will undertake projects on various topics related to industrial management, including, Forms of Legal Ownership, Financial Management, Marketing Management, Project Cost Estimation, Plant Location & Layout, Inventory Management.

Teaching-Learning Methodology	Courses for B. Sc. Industrial Chemistry program is 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 (Practical Examination, Viva – Voce) (As per NEP – 2020)	50%
2.	University Examination	50%

Course Outcomes: Upon completion of this course, students will be able to:

- Develop a fundamental understanding of business organization and management principles.
- Gain hands-on experience with chemical industry management practices.
- Acquire knowledge of essential financial, marketing, and operational strategies in industrial settings.
- Apply theoretical concepts to real-world industrial scenarios through case studies and project work.

Suggested References:	
Sr. No.	References
1.	Koontz, H., & Weihrich, H. – *Essentials of Management: An International Perspective*
2.	Robbins, S. P., Coulter, M. – *Management*
3.	Hill, C. W. L., & Jones, G. R. – *Strategic Management: Theory*

4.	Kotler, P., Keller, K. L. – *Marketing Management*
5.	Kapoor, N. D. – *Elements of Business Law*
6.	Pandey, I. M. – *Financial Management*
7.	Bose, D. C. – *Inventory Management*
8.	Chary, S. N. – *Production and Operations Management*

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

*****

SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.11)
(Effect from : 2025-26)

(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester -V

Course Code	**US05SECCHE01**	Title of the Course	**ANALYTICAL AND PHYSICAL CHEMISTRY PRACTICAL**
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	To make students familiar with: 1. Practical chemistry as a subject 2. Practical aspects of physical and analytical chemistry.

Course Content	**Total Marks : 50**
Unit	Description
Practical-I	**Estimation of Functional Group** (i) Estimation of Carboxylic Acid (ii) Estimation of Ketone (iii) Estimation of Ester (iv) Estimation of amide (v) Estimation of aspirin **Chemical Kinetics** (i) Chemical kinetics of a reaction between $K_2S_2O_8$ and KI in an aqueous system. (a=b) (ii) Chemical kinetics of a reaction between $K_2S_2O_8$ and KI in an aqueous system. ($a \neq b$) (iii)To determine the rate constant for the reaction between $KBrO_3$ and KI in an aqueous media. (a=b) **VIVA EXAMINATION**

Teaching-Learning Methodology	Hands on training of Practicals: 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 : Class test/Internal written test 10 Marks (40%), Quiz 05 Marks (20%), Home Assignments 05 Marks (20%), Attendance 05 Marks (20%), (As per SPU Letter No. E-3/2748 dated 02/02/2024) [Total 25 Marks (100%)].	50
2.	Semester End Examination [Total 25 Marks (100%)].	50

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn performing chemical experiments under time constrain and appreciate the physical and analytical principles useful in chemical science.
2.	Apply in further studies and in industries.

Suggested References Books:	
Sr. No.	References Books:
1.	Practical Chemistry By O. P. Pandey, D. N. Bajpai & S. Giri
2.	An Advanced Course In Practical Chemistry By Ghoshal, Mahapatra & Nad
3.	Comprehensive practical organic chemistry Preparation and qualitative analysis by V. K. Ahuwalia and Renu Agarwal.
4.	Organic Preparation by A. I. Vogel
5.	Vogel's Text book of Quantitative Chemical Analysis, 5th Edition By G. H. Jeffery, J. Basset, J. Mendham, R. C. Denney.
6.	Experimental Physical Chemistry by R. C. Das & B. Behera

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

*****