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(Bachelor of Science) (Undergraduate)

B. Sc. (UG) Semester -V

Course Code	US05MACHE01	Title of the Course	ORGANIC CHEMISTRY
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 spectroscopic techniques.
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Course Content		
Unit	Description	Weightage* (%)
1.	HETEROCYCLIC COMPOUNDS Heterocyclic systems, Structure of Pyrole, furan and thiophene, Source of Pyrole, furan and thiophene, Electrophilic 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, Mannich reaction, Birch reduction, Wittig reaction, Perkin condensation reaction, Benzoin condensation, Hofmann rearrangement, Curtius–Schmidt rearrangement, Benzilic acid rearrangement, Sommelet rearrangement, Favorskii rearrangement, Beckmann rearrangement.	25%

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3.	INFRARED & MASS SPECTROSCOPY INFRARED SPECTROSCOPY: Introduction, Important terms and definitions of IR spectroscopy, principle of IR spectroscopy, instrumentation, sampling technique, selection rules, Finger print region, types of bonds, absorption of common functional groups. Factors affecting vibrational frequencies, Overtones and combination bond, Fermi resonance. Differentiate two compounds by the IR frequencies, Application of IR spectroscopy, Important tips for interpreting an IR spectrum, Problems pertaining to the structure elucidation of organic compounds using IR. Infrared spectra of hydrocarbons, Infrared spectra of alcohols, Infrared spectra of ethers. MASS SPECTROSCOPY: Basic principles, Theory, Mass spectrum, Ionization of a molecule on electron impact (E1) – presentation of molecular ion, The molecular ion and its intensity, The base peak, the mass spectrum, ratio of mass to charge(m/z), instrumentation, fragmentation, McLafferty rearrangement, Important features in mass spectroscopy. Numericals based on IR and Mass spectroscopy.	25%
4.	NMR SPECTROSCOPY (¹H & ¹³C) 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, Carbon – 13 NMR (CMR) spectroscopy, CMR Splitting, CMR Chemical shift, NMR and CMR spectra of hydrocarbons, NMR and CMR spectra of alkyl halides NMR and CMR spectra of alcohols and ethers. Spectroscopic analysis of aldehydes and ketones. Spectroscopic analysis of Carboxylic acids, Spectroscopic analysis of amines and substituted amides, Spectroscopic analysis of Carboxylic acid derivatives. Numericals based on IR, NMR and Mass spectroscopy.	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).
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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, Mass & NMR spectroscopy.
2.	Understanding of above studies will be helpful in further higher studies and in industries.

Suggested References Books:

Sr. No.	References
1.	Organic chemistry by Morrison and Boyd, 6 th ed.
2.	Organic reaction mechanism by R. K. Bansal, 3 rd ed.
3.	Organic chemistry by S. M. Mukherji, S. P. Singh and R. P. Kapoor. Vol. II.
4.	Heterocyclic chemistry vol.II by R. R. Gupta, M. Kumar and V. Gupta
5.	Spectroscopy of Organic compounds by P. S. Kalsi 8 th Ed.
6.	Elementary Organic Spectroscopy by Y R Sharma

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7.	Introduction to Spectroscopy: Donald L. Pavia, Gary M. Lampman, George S. Kriz Cengage Learning; 4th Edition.
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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 - 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.
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Course Content		
Unit	Description	Weightage* (%)
1.	ELECTROANALYTICAL METHODS : pH-METRY: Introduction, types of indicator electrodes and reference electrodes, types of titrations. POTENTIOMETRY: Introduction, types of titrations, graphical method for end point determination. CONDUCTOMETRY: Introduction, types of conductance, effect of dilution, conductivity cells, types of titration. Industrial applications and importance of pH-Metry, Potentiometry and Conductometry.	25%
2.	CHROMATOGRAPHY – I Introduction, classification, paper chromatography, thin layer chromatography, column chromatography, ion-exchange chromatography, experimental details for all the techniques. Industrial applications and importance of chromatography.	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. Industrial applications and importance of Gas chromatography.	25%



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	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 separation, Detectors. Industrial applications and importance of HPLC chromatography	
4.	SOLVENT EXTRACTION METHODS: The Distribution Law, Extraction process, Liquid liquid extraction, Factor affecting Extraction, Technique for Solvent Extraction, Quantitative treatment of solvent Extraction equilibria, 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).
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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
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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.

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
4	Analytical chemistry by G. D. Christian
5	Quantitative inorganic analysis by A. I. Vogel 3rd edition.

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 -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.
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Course Content	Total Marks : 100
Unit	Description
Practical -I	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, Liquid base:- aniline, Liquid neutral:- ethyl acetate, methyl acetate, acetone, methyl alcohol, ethyl alcohol, benzaldehyde, chlorobenzene, nitrobenzene, Chloroform, acetophenone (Derivative of identified compounds) VIVA EXAMINATION
Practical -II	ANALYTICAL CHEMISTRY PRACTICAL 1. Gravimetric Analysis (Mixture with interfering radicals like removal of Cu) [Any one experiment can be asked in University Exam] 1. Fe as Fe_2O_3 2. Ba as BaSO_4 3. Al as Al_2O_3 4. Zn as $\text{Zn}_2\text{P}_2\text{O}_7$ 5. Cr as Cr_2O_3

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	6. Ni as Ni(DMG)₂ 2. Volumetric Analysis by self preparation of EDTA 1. Estimation of Bi³⁺ by EDTA. 2. Estimation of Cu²⁺ by EDTA. 3. To determine the amount of Ca from limestone. 4. To determine the amount of Cu by iodometry from a given solution of CuSO₄·5H₂O. 5. To determine the amount of Cd and Zn by EDTA. VIVA VOCE EXAMINATION
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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).
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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.

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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, 5 th 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

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(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.
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Course Content		
Unit	Description	Weightage* (%)
1.	(A) ORGANO METALLIC CHEMISTRY: Introduction, General methods of preparations, General properties, Organometallic compounds of alkali metals, Organometallic compounds of beryllium, Organometallic 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 iron, manufacture of cast iron & steel, Cu: occurrence & extraction electrolytic refining of copper, properties and uses of copper.	50%



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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).
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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.	Students will learn 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 -20th edition, 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 INORGANIC CHEMISTRY : 5TH EDITION BY: J.D.LEE
4.	Basic Inorganic Chemistry- 3 rd Edition By F. Albert Cotton, Geoffery Wilkinson &

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	Paul L. Gaus
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On-line Resources: Google books, INFLIBNET, Google Web

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(Bachelor of Science) (Undergraduate)

B. Sc. (UG) Semester - V

Course Code	US05MICHE02	Title of the Course	INORGANIC CHEMISTRY 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.
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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 $\rightarrow$ NaOH (iv) Titration of Succinic acid $\rightarrow$ KOH (v) Titration of Oxalic Acid $\rightarrow$ KOH TITRIMETRIC ANALYSIS (REDOX TITRATION) (vi) Titration of $\text{KMnO}_4 \rightarrow \text{FeSO}_4(\text{NH}_4)_2 \cdot \text{SO}_4 \cdot 6 \text{H}_2\text{O}$ (vii) Titration of $\text{K}_2\text{Cr}_2\text{O}_7 \rightarrow \text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ using internal indicator diphenylamine sulphate. (viii) Titration of $\text{KMnO}_4 \rightarrow$ Oxalic acid (ix) Titration of $\text{KMnO}_4 \rightarrow \text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ VIVA-VOCE EXAMINATION

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.
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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.	Students will learn about 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



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(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. Basic Physical Chemistry concepts. 2. Understanding significance of photochemistry and colloidal state.
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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, Fluorescence and Phosphorescence, Numericals.	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, Numericals.	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).
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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.	Students will 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. 38 th Edition.
4.	Essential of physical chemistry by Bahl, Bahl and Tuli. 25 th edition.
5.	Physical Chemistry by G. M. Barrow, 5 th 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

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9.	Physical Chemistry, Ira Levine
10.	Physical Chemistry, Atkins
11.	Principles of polymers Science by P. Bahadur and N. V. Sastry (2 nd 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

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(Bachelor of Science) (Undergraduate)

B. Sc. (UG) Semester - V

Course Code	US05MICHE04	Title of the Course	VOLUMETRIC ANALYSIS PRACTICAL
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	To make students familiar with: 1. Practical aspects of volumetric analysis. 2. Hands on experience of volumetric titration.
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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 EXAMINATION

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.
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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



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2.	Semester End Examination [Total 25 Marks (100%)].	50
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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



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Bachelor of Science

Undergraduate

B. Sc. Chemistry

Semester – V

(Effective from JUNE - 2026)

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).
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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 Publication, 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



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Bachelor of Science

Undergraduate

B. Sc. Chemistry

Semester – V

(Effective from JUNE - 2026)

Course Code (Minor Practical)	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.
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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).
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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.



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Bachelor of Science

Undergraduate

B. Sc. Chemistry

Semester – V

(Effective from JUNE - 2026)

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 electro thermal industries and fundamental principles of electrochemical industries.
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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.	Electro thermal 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).
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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 electro thermal 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

OnlineResources: Google Books, INFLIBNET, Google Web



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B. Sc. Chemistry

Semester – V

(Effective from JUNE - 2026)

Course Code (Minor Practical)	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.
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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).
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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.

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Online Resources: Google Books, INFLIBNET, Google Web



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Semester – V

(Effective from JUNE - 2026)

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.
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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).
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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"

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Semester – V

(Effective from JUNE - 2026)

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.
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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).
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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. – <i>Essentials of Management: An International Perspective</i>
2.	Robbins, S. P., Coulter, M. – <i>Management</i>
3.	Hill, C. W. L., & Jones, G. R. – <i>Strategic Management: Theory</i>
4.	Kotler, P., Keller, K. L. – <i>Marketing Management</i>
5.	Kapoor, N. D. – <i>Elements of Business Law</i>
6.	Pandey, I. M. – <i>Financial Management</i>
7.	Bose, D. C. – <i>Inventory Management</i>
8.	Chary, S. N. – <i>Production and Operations Management</i>

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

Online Resources: Google Books, INFLIBNET, Google Web
