(Bachelor of Science) (Undergraduate) (Industrial Chemistry)

B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code (Major)	**US05MAICH01**	Title of the Course	**Advance Organic Chemistry**
Total Credits of the Course	4	Hours per Week	4

Course Objectives	To make students familiar with: 1. Various name reaction and reagents utilized for chemical reactions in the industries. 2. The basics of polynuclear hydrocarbon. 3. The basics of spectroscopy and its application in organic chemical analysis.

Course Content		
Unit	**Description**	**Weightage*(%)**
1.	**Reaction Mechanism**: Hoffmann- Loffler Reaction, Baeyer Villiger Oxidation, Hunsdiecker Reaction, Benzoin Condensation. **Concept of rearrangement-** Favorskii rearrangement, Beckman Rearrangement, Benzilic acid Rearrangement and Pinacol-Pinacolone rearrangement.	**25%**
2.	**Reagents of synthetic importance**: Aluminium isopropoxide, Diazomethane, Lead tetra acetate, Lithium aluminum hydride ($LiAlH_4$), Sodium borohydride ($NaBH_4$), Lithium diisopropylamide (LDA), N-Bromosuccinimide (NBS), Osmium tetroxide, Ozone, Selenium dioxide and selenious acid.	**25%**
3.	**Polynuclear hydrocarbon**: Introduction, Nomenclature, Structure, preparation and reaction of Naphthalene, anthracene and Phenanthrene.	**25%**
4.	**Ultraviolet (UV) and Visible Spectroscopy:** Introduction, Instrumentations, electronic transitional definition of some terms and designation of UV absorption bands, general applications of Ultraviolet spectroscopy. **Infrared Spectroscopy**: Introduction, Instrumentations, stretching and bending vibrations, Applications of IR spectroscopy, Interpretation of IR spectra-characterization of functional groups and structural diagnosis. **NMR Spectroscopy:** Introduction, Instrumentations, shielding and deshielding, chemical shift, spin-spin splitting and coupling constant, area of signal, interpretation of PMR spectra of various simple organic molecules, Problems pertaining to the structure elucidation of organic compounds using UV, IR, Mass and PMR spectroscopy.	**25%**

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.	Learn about various name reaction and reagents utilized for chemical reactions having direct applicability in the industries.
2.	the basics of polynuclear hydrocarbon.
3.	the basics of spectroscopy and its application in organic chemical analysis.

Suggested References:	
Sr. No.	References
1.	Organic Chemistry by Robert T. Morrison and Robert T. Boyd (5^{th} Edition, Prentice Hall of India Pvt. Ltd. New Delhi)
2.	Organic Chemistry by R. K. Bansal (Tata McGraw – Hill Publishing Co. Ltd. New Delhi)
3.	Organic Chemistry by M. K. Jain and S. C. Sharma (Vishal publishing Co., Jalandhar).
4.	Spectroscopy of Organic Compounds by P. S. Kalsi (New Age International Publishers)
5.	Spectroscopy (Atomic & Molecular) by Gurdeep Chatwal (Himalaya Publishing House)

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) (Industrial Chemistry)
B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code (Major)	US05MAICH02	Title of the Course	Fluid Mechanics & Mechanical Operations
Total Credits of the Course	4	Hours per Week	4

Course Objectives	To make students familiar with: 1.Understanding Fluid Mechanics & Study of Fluid Moving Machinery 2.Understanding Mechanical Operations like Size Reduction Filtration, Sedimentation, Mixing and Conveyors.

Course Content		
Unit	Description	Weightage*(%)
1.	Fluids & their classification, Viscosity, Newtonian and non-Newtonian fluids, Static pressure, Manometer, Mechanism of fluid flow, Types of flow, continuity equation, Bernoulli's theorem, friction factor & friction head Fluid moving machineries, Equipment's, Pipes and pipe fittings, Pumps Classification and Performance, Reciprocating and Rotary pumps, Centrifugal pumps, Blower, Compressors, Vacuum pump.	25%
2.	Size reduction and size separation, Primary and secondary crushers, Fine grinders, Methods of operating crusher, Size separation of solids, Industrial screens, Air separation method, Size separation by laws of setting.	25%
3.	Filtration, Rate equation, Filter media and filter aid, Industrial Filters-Sand filter, Plate & frame filter, Leaf filter, Rotary filter and Centrifugal Filtration. Sedimentation- Batch and continuous sedimentation, Thickeners, Separation of solids based on specific properties. Clarification equipment's. Cyclones. Froth flotation and Jigs.	25%
4.	Mixing, Types of mixing problems, mixing liquids with liquids, mixing liquids with solids, mixing solids with solids, Mixing viscous masses. Conveyors and elevators-Introduction Belt conveyor, Conveyor, Screw conveyor, Pneumatic conveyor.	25%

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.	Learn the core concepts related to fluids, types of fluids, their movement and their flow properties as well as engineering related to the equipment used for transporting fluids and controlling their flow.
2.	The students will also get exposed to various mechanical operations employed in chemical industries and will gain knowledge about the use and application of such mechanical concepts at various levels of chemical processes.

Suggested References:	
Sr. No.	References
1.	Unit Operations: Volume I & II, by K. A. Gavhane (Nirali Prakashan-Pune)
2.	Introduction to Chemical Engineering by Walter L Badger and Juline T Banchero (McGraw-Hill Book Co.)
3.	Unit Operation of Chemical Engineering by Warreh L Mc Cabe & Jullian C Smith (McGraw-Hill Book Co.)
4.	Chemical Engineering (volume I & II) by J. M. Coulson & K. F. Richardson (Asian Books Pvt. Ltd., 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) (Industrial Chemistry)

B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code (Major Practical)	**US05MAICH03**	Title of the Course	**Industrial Chemistry – Practical**
Total Credits of the Course	04	Hours per Week	08

Course Objectives:	This paper of practical will provide hands on exposure to students towards preparation and estimation of Intermediates and Drugs based on various Unit Process. Also, it will help will learn about hands on training of various mechanical operations like size reduction, solid-solid separation, mixing, filtration etc. Also, they will learn the calculations related to process parameters used in chemical industries.

Course Content
Part – I: - Preparation of Intermediates for API based on Unit Process, Quantitative organic Analysis: Estimation and Analysis of Intermediates and finished intermediates and API. Part – II :- Study of characterization of Solid particles by Screen Analysis, Size reduction of solids using crushers & grinders and product analysis by differential analysis by cumulative analysis, Study on efficiency of separation using cyclone separator, Study of pipe fittings, pumps and flow meter, Pressure measurement in gas line with manometer, Fluid flow study-/Reynolds experiment, Differential pressure meter, Study on filtration operation, Study on working of laboratory centrifuge, Study on solid-liquid mixing and solid mixing. Experiment based on various unit operations.

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

Course Code (Minor)	**US05MIICH01**	**Title of the Course**	**Petroleum and Petroleum Products**
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

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

Course Code (Minor)	**US05MIICH02**	**Title of the Course**	**Petroleum and Petroleum Products – 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, purification and analysis of various inorganic heavy and fine chemicals.

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, purification and preparation ofinorganic heavy and finechemicals for the subject of industrial chemistry.

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

Course Code (Minor)	**US05MIICH03**	Title of the Course	**Chemical Process Technology**
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make students familiar with: 1. Understand the Manufacture and Properties of Nitrogenous Products. 2. Explore Electrothermal Industries, Gain Insight into Electrochemical Industries.

Course Content		
Unit	Description	Weightage*(%)
1.	Nitrogenous Products: Manufacture and study of properties of synthetic nitrogen products and miscellaneous inorganic chemicals such as ammonia and various types of nitrogenous fertilizers such as urea, ammonium sulphate, ammonium nitrate, calcium ammonium nitrate.	**50%**
2.	Electro thermal industries: Introduction, uses and economics of furnaces and their classification, manufacture of silicon carbide, calcium carbide, boron carbide, boron nitride, synthetic graphite, carbon electrode. Electro-chemical Industries: Magnesium anhydrous, $MgCl_2$, MgO, hydrogen peroxide, potassium permanganate, hydroxyl amine.	**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.	“Industrial Chemistry” by B. K. Sharma.
2.	“Shreve’s Chemical Process Industries” by G. T. Austin
3.	"Chemistry and Technology of Fertilizers" by Vincent Sauchelli
4.	"Handbook of Industrial Furnaces and Kilns" by Charles A. Schacht
5.	"Electrochemical Engineering" by Thomas F. Fuller and John N. Harb

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) (Industrial Chemistry)
B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code (Minor Practical)	**US05MIICH04**	Title of the Course	**Chemical Process Technology – Practical**
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	This paper will Develop the skill of students towards preparation of fine chemicals, purification of the product and analysis of various inorganic heavy and fine chemicals.

Course Content
Preparation, purification and estimation of fine chemicals such as Tetraamine amine copper (II) sulphate, Tetra thiourea copper (I) sulfate, Sodium thiosulfate, Hexa-thiourea Lead Nitrate, Chrome Red, Magnesium Hydroxide, Magnesium Carbonate, Magnesium Trisilicate, Magnesium Stearate, Zinc Stearate etc. Preparation of various industrial metal supported catalyst, Extraction and purification of industrial solvent, Physical and performance parameter of coating.

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 methods for purification and preparation of inorganic heavy and fine chemicals for the subject of industrial chemistry.

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

Course Code (Minor)	**US05MIICH05**	Title of the Course	**Business Organization & Management – I**
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make students familiar with: 1. Understanding Business Ownership, Entrepreneurship Skills, Financial Acumen. 2. Marketing Insight: Decision-Making and Analysis: Practical Application

Course Content

Unit	Description	Weightage*(%)
1.	Forms of legal ownership, Ideal form of an organization, Feature, Advantages and disadvantages of Sole proprietorship, Partnership, Co-operative. Joint Hindu Family Organization and Joint Stock Company. Entrepreneurship decision, Launching of a new enterprise, Principle of management.	**50%**
2.	Financial management (source of finance, working and fixed capital). Interest and Depreciation, Taxes and Insurance. Marketing management (core concepts of marketing), Pricing policy, Break Even Analysis, Profitability criteria and selection of alternatives.	**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.	The course will guide students through the critical decisions involved in entrepreneurship and launching new enterprises, including the application of fundamental management principles to establish and grow a successful business.
2.	Financial management topics will cover sources of finance, the management of working and fixed capital, and essential concepts such as interest, depreciation, taxes, and insurance, providing students with the tools needed to manage the financial health of an organization.

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

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) (Industrial Chemistry)
B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code (Minor Practical)	**US05MIICH06**	Title of the Course	**Business Organization & Management – 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

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

Course Code	**US05MIICH07**	Title of the Course	**FUNDAMENTALS OF PHYSICAL CHEMISTRY**
Total Credits of the Course	02	Hours per Week	02

Course Objectives:	To make students familiar about: 1. Physical Chemistry and polymer science. 2. Understanding of significance of phase rule and polymer chemistry.

Course Content		
Unit	Description	Weightage* (%)
1.	**PHASE EQUILLIBRIA:** Introduction to Phase rule, Phase component and degree of freedom, Phase reactions, condition for equilibrium between phases, derivation of phase rule, advantage and limitations of phase rule, one component system, water system, the sulfur system, experimental determination of transition point, two component system, simple eutectic system, lead silver system.	**50%**
2.	**POLYMER CHEMISTRY:** Introduction, Classification of polymers, Chain growth polymerization – Introduction, Mechanism of free-radical, Cationic and Anionic polymerization, Kinetics of free radical, Cationic and Anionic polymerization, Mechanism and Kinetics polycondensation, 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).

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 Polymer science, its kinetics and phase equillibria.
2.	Know the basics to enable student in further studies and prepare for role in industries.

Suggested References:	
Sr. No.	References
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

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

Course Code	**US05MIICH08**	Title of the Course	**FUNDAMENTALS OF PHYSICAL CHEMISTRY PRACTICAL**
Total Credits of the Course	02	Hours per Week	04

Course Objectives:	To make students familiar about: 1. 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
	Introduction to chemical laboratory, use of glassware, chemical and reagents, organic and inorganic solvents, bench reagents, side reagents, safety practices in the chemistry laboratory, knowledge about toxic chemicals and safety precautions in their handling.
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:	
Sr. No.	References
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	**US05MIICH09**	Title of the Course	**FUNDAMENTALS OF 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-	Conventional method (classroom blackboard teaching), ICT.

Learning Methodology	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 organometallic compounds and metallurgy.
2.	Know the basics to enable student in further studies and prepare for role in industries.

Suggested References:	
Sr. No.	References
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

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

Course Code	**US05MIICH10**	Title of the Course	**FUNDAMENTALS OF INORGANIC CHEMISTRY PRACTICAL**
Total Credits of the Course	02	Hours per Week	04

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

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

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 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.	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) (Industrial Chemistry)

B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code	**US05SEICH01**	Title of the Course	**Industrial Safety & Hygiene**
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make students familiar with: 1. The basic knowledge of various types of safety required in chemical industries. 2. The knowledge of process that produces Hazardous chemicals & its Control, safety during transportation of chemicals, Inspections of chemical factories etc.

Course Content		
Unit	Description	Weightage*(%)
1.	Safety in chemical industries: Place of chemical industries in society, Statutory provisions, Types of chemical hazards & its control, General safety precautions.	**50%**
2.	Occupational Health Industrial Hygiene & Occupational Health, Occupational Health Hazard, Adverse Health Effect & its Control, Types and limits of radiation, Dangerous properties of chemicals and their health effect, Routes of entry & its toxic effects, Evaluation of Health Hazards, Sampling analysis in gas.	**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.	Understand the places of chemical industries, statutory provisions of chemical industries, different types of chemical hazards & its control & the safety precautions.
2.	To acquire the basic knowledge of process Hazard & its Control, safety during transportation of chemicals, Inspections of chemical factories, etc.

Suggested References:	
Sr. No.	References
1.	Fundamental of Industrial safety & Health-volume-1 by Dr. K.S. Mistry.
2.	Fundamental of Industrial safety & Health-volume-2 by Dr. K.S. Mistry.

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) (Industrial Chemistry)

B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code	**US05SEICH02**	Title of the Course	**Industrial Hazards & Management**
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make students familiar with: The basic knowledge of various types of hazardous chemical in industries, types of tests, certificate & records. Moreover, students will gain the knowledge of management of chemical industries, safety & its responsibilities of employs, safety organizations, safety management education & training.

Course Content		
Unit	Description	Weightage*(%)
1.	Hazards & Control: Process of Hazard & its Control, Utility of Hazards & its control, Safety transportation of chemicals, checklist of routine inspections of chemical factories, Types of tests, certificate & records, permits for vessel entry.	**50%**
2.	Safety management: Concept of management, element of management, principle of management, safety & its responsibilities, safety organizations, department & programme, safety education & training.	**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.	This paper will inculcate knowledge of Hazard & its Control, Uses of Hazards & its control, transportation of chemicals, routine inspections of chemical factories, Types of tests, certificate & records for documentation, etc.
2.	Moreover, students will gain the knowledge for the management chemical industries, various element of management, role of safety manager, safety education & training, etc.

Suggested References:	
Sr. No.	References
1.	Fundamental of Industrial safety & Health-volume-1 by Dr. K.S. Mistry.
2.	Fundamental of Industrial safety & Health-volume-2 by Dr. K.S. Mistry.

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) (Industrial Chemistry)
B. Sc. (UG) Semester – V (Effective from JUNE 2025)

Course Code	**US05SEICH03**	Title of the Course	**Chemical Engineering Drawing**
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make students familiar with: 1. Understanding the standard symbols and conventions used in chemical engineering equipment drawings. Developing proficiency in creating and interpreting block flow diagrams and process flow diagrams. 2. Learning the fundamentals of mounting and fitting parts in chemical processing equipment.

Course Content		
Unit	Description	Weightage*(%)
1.	Chemical Engineering Equipment Drawing: Standard symbols and conventions used in chemical engineering, Representation of various equipment used in chemical processes, Standardized codes and symbols for process equipment, sketching of essential components such as: Valves (gate, globe, ball, and butterfly valves), Pipe fittings (elbows, tees, reducers, unions, and flanges), Joints (threaded, welded, flanged, and expansion joints).	**50%**
2.	Diagrams for Chemical Engineering: Freehand sketching of equipment used in unit operations, Preparation and interpretation of block flow diagrams (BFDs) and process flow diagrams (PFDs), Usage of appropriate symbols for representing industrial processes, Integration of equipment symbols into process diagrams.	**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.	Apply standard engineering symbols and conventions to represent chemical process equipment.
2.	Develop process flow diagrams and block flow diagrams for chemical plants.
3.	Demonstrate proficiency in sketching fundamental components used in industrial chemical engineering applications.
4.	Interpret engineering diagrams effectively for industrial applications.

Suggested References:	
Sr. No.	References
1.	Bhatt, N. D., & Panchal, V. M. - "Machine Drawing" (Latest Edition, Charotar Publishing House)
2.	Gopala Rao, M. - "Manufacturing Technology" (McGraw Hill Education, Latest Edition)
3.	Austin, G. T. - "Shreve's Chemical Process Industries" (McGraw Hill, Latest Edition)
4.	Ludwig, E. E. - "Applied Process Design for Chemical and Petrochemical Plants" (Gulf Professional Publishing, Latest Edition)
5.	Perry, R. H., & Green, D. W. - "Perry's Chemical Engineers' Handbook" (McGraw Hill, Latest Edition)

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

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