Sir P. T. Sarvajanik College of Science

Autonomous

Affiliated to Veer Narmad South Gujarat University, Surat

Re-Accredited 'A+' with CGPA 3.35

SYLLABUS

FOR

SEM I

Program: B. Sc.

Course: Chemistry

Academic year

2025-26

(NEP-2020)

(To be effective from June, 2025)

SEMESTER I

Major Course- I

COURSE NAME: Chemistry Paper I

COURSE CODE: CHEMJ-S1P1-3CR25 **[CREDITS - 03]**

Course learning outcome
At the end of this course, Students will be able to 1. Define vapour pressure, osmotic pressure, melting point, and boiling point of solutions; Calculate the changes in vapour pressure, osmotic pressure, melting point, and boiling point of solutions; Calculate the compressibility factor, viscosity, different collision parameters. 2. Explain laws of continuity of states, explain laws of corresponding states; Solve numerical problems involving gas laws, etc. 3. Define and explain the orders of reactions and basic terms of chemical kinetics; Identify factors affecting rate of reactions; Define kinetics of catalytic reactions. Solve numerical problems involving rate laws. 4. Define basic physical properties, outline the fundamental concepts of atomic structure; Calculate quantum numbers and effective nuclear charge; Interpret atomic spectrum and depict different orbitals in atoms. 5. Describe the periodic table; Define the principal resemblances of elements within each main group of the periodic table; Compare the trends of different properties of the elements in the periodic table. 6. Define different types of chemical bonds; Compare and describe theories of chemical bonding; Classify the types of hybridization; Apply the theories for predicting the geometric structures of molecules; Calculate bond order of different diatomic molecules.

Module 1	**Physical Chemistry I**	**[15 L]**

Learning Objective:

- To familiarize the student with the fundamental concepts of gaseous phase, kinetics and processes of mathematical calculations.

Learning Outcomes:

At the end of this module the learner will be able to

1. Define vapour pressure, osmotic pressure, melting point, and boiling point of solutions;
2. Calculate the changes in vapour pressure, osmotic pressure, melting point, and boiling point of solutions; calculate the compressibility factor, viscosity, different collision parameters.
3. Explain laws of continuity of states, explain laws of corresponding states; Solve numerical

problems involving gas laws, etc.		
1.1	**Chemical Mathematics:** Chemical Mathematics: Scientific notation, powers and roots, Logarithms, graphical presentation of functions, differential calculus, Integral calculus. Problems.	**[4 L]**
1.2	**Gaseous State:** Elementary aspects of kinetic theory of gases, Ideal and real gases. Boyle temperature (derivation not required), Molecular velocity, Collision parameters (frequency, diameter, cross section, number and mean free path), Coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure.	**[5 L]**
1.3	**Behaviour of real gases:** Deviation from ideal gas behaviour. Compressibility factor (Z) and its variation with pressure for different gases. Causes of deviation, van der Waals equation of state (No derivation) and application in explaining real gas behaviour. Critical phenomena - Andrews isotherms of CO_2. Numerical problems.	**[6 L]**
Module 2	**Basics of Chemistry I**	**[15 L]**
Learning Objective • To study basic properties of chemistry e.g. chemical kinetics and atomic structure		
Learning Outcomes: At the end of this module the learner will be able to 1. Define and explain the orders of reactions and basic terms of chemical kinetics; Identify factors affecting rate of reactions; Define kinetics of catalytic reactions. Solve numerical problems involving rate laws. 2. Define basic physical properties, outline the fundamental concepts of atomic structure; Calculate quantum numbers and effective nuclear charge; Interpret atomic spectrum and depict different orbitals in atoms.		
2.1	**Chemical Kinetics:** Chemical kinetics and its scope, rate of reaction, factors affecting rate of reaction: temperature, concentration, pressure, solvent, light and catalyst, Molecularity of reaction, Classification of chemical reaction, Order of reaction with illustration (first order, second order, third order, zero order, pseudo first order) reaction, second order (a=b), half-life and mean life. Numerical Problems.	**[7 L]**
2.2	**Atomic Structure:** Rutherford atomic model, Bohr's theory and it's limitations, atomic spectrum of hydrogen atom, de Broglie equation,	**[8 L]**

	Heisenberg's Uncertainty Principle and its significance, Quantum numbers and their significance, Shapes of s, p, d and f orbitals, Aufbau principle, Hund's rule, Pauli exclusion principle, Effective nuclear charge (Slater Rule).	
Module 3	**Inorganic Chemistry I**	**[15 L]**

Learning Objective:

- To perceive basics of periodic properties, chemical bonding, VSEPR theory, structure and bonding in complexes

Learning Outcomes:

At the end of this module the learner will be able to

1. Describe the periodic table; Define the principal resemblances of elements within each main group of the periodic table; Compare the trends of different properties of the elements in the periodic table.
2. Define different types of chemical bonds; Compare and describe theories of chemical bonding; Classify the types of hybridization; Apply the theories for predicting the geometric structures of molecules; Calculate bond order of different diatomic molecules.

3.1	**Periodic properties:** Long form of periodic table, general properties of period and group elements; variation of orbital energy with atomic number, Discussion of the general properties of the elements along the period and group (Atomic/Ionic radii, electronegativity, IE, EA energy), application of electronegativity, Pauling's scale of electronegativity, Diagonal relationship.	**[7 L]**
3.2	**Chemical Bonding:** Definition of chemical bonds, Types of bonds – (Introductory), Valence Bond Theory, Concept of hybridization. Types of hybridization involving s, p, & d orbitals, VSEPR theory with examples, Basics of MO theory, MO – bonding, non-bonding, anti-bonding, MO diagram of O_2, N_2, CO and NO; Bond order.	**[8 L]**

List of Major Textbooks:

1. Essential of physical chemistry by A.S. Bahl and G.D. Tuli; Pub.: S. Chand
2. Advance physical chemistry by D.N. Bajpai, Pub.: S. Chand.
3. Numerical problems by D.V.S. Jain, Pub.: Mac Graw Hill (Numericals)
4. Advanced Physical Chemistry by Gurdeep Raj, 19/E, Goel Publishing House, Meerut.
5. Physical Chemistry by P. W. Atkins, 10/E, 2002, Oxford University Press, Indian Ed.

6. Principles of physical chemistry by Puri, Sharma and Madan; Pub. Vishal publishing.
7. Nag, A. K, Physical Chemistry Vol. 1, 2, McGraw Hill.
8. Castellan, G. W. (2004), Physical Chemistry, 4th Edition, Narosa.
9. Kapoor, K.L. (2015), A Textbook of Physical Chemistry, 6th Ed, McGraw Hill Education.
10. Concise Inorganic Chemistry by J. D. Lee, 5/E, Oxford University Press, Indian Edition.
11. Basic Inorganic Chemistry by F. A. Cotton and G. Wilkinson, Wiley publication.
12. Inorganic Chemistry by Shriver & Atkins, 4/E, Oxford University Press, Indian Edition.
13. General and Inorganic Chemistry: Volume I by R. P. Sarkar, New Central Book Agency; 3rd Revised edition (1 July 2011), India
14. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E.A. Keiter, R.L. Keiter, Pearson; 4th edition (1997).
15. Inorganic Chemistry by Shriver, Atkins and Langford, Pubs: W H Freeman & Co (1994).

e-Resources:

1. **https://nptel.ac.in/courses/104104026**
2. **https://courses.lumenlearning.com/suny-introductory-chemistry/chapter/real-gases/**
3. **Swayam Prabha with IITDelhi: https://www.youtube.com/watch?v=syhwfcv3Qhc ; https://www.youtube.com/watch?v=3Yenk-KQAOI**
4. **https://sathee.prutor.ai/jee-chemistry/atomic-structure/**
5. **https://archive.nptel.ac.in/content/storage2/courses/104103019/module1/lec1/1.html**
6. **Swayam with IITMadras : https://www.youtube.com/watch?v=ZVPrpvEg4_0**
7. **https://archive.nptel.ac.in/courses/104/101/104101090/**
8. **https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/95**

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1.	√		√				√		
2.	√	√	√				√		
3.	√	√	√				√		
4.	√	√							
5.		√	√				√		
6.	√	√		√					

SEMESTER I

Major Course - II

COURSE NAME: Chemistry Paper II

COURSE CODE: CHEMJ-S1P2-3CR25 **[CREDITS - 03]**

Course learning outcome
At the end of this course, Students will be able to 1. Define and write different methods of synthesis, mechanisms of chemical reaction of alkanes and cycloalkanes. 2. Apply the rules of IUPAC nomenclature to write the names and structure of organic compounds. 3. Classify hydrocarbons and write their structural formulas. 4. Explain hybridization with suitable examples. 5. Explain and classify the stereochemistry of organic molecules – conformation and configuration, asymmetric molecules and nomenclature. 6. Define and explain hybridization and geometry of atoms, 3-D structure of organic molecules, identifying chiral centres. 7. Explain different types of organic reactions with their examples. 8. Illustrate the basics, methods of synthesis and chemical reactions of heterocyclic compounds, aromatic hydrocarbons.

Module 1	**Alkanes, cycloalkanes & IUPAC nomenclature**	**[15 L]**

Learning Objective:

- To familiarize the student with the fundamental concepts, reactivity and chemical properties of alkanes and cycloalkanes.
- To make students understand and write the IUPAC nomenclature of organic compounds.

Learning Outcomes:

At the end of this module the learner will be able to:

1. Define and write different methods of synthesis, mechanisms of chemical reaction of alkanes and cycloalkanes.
2. Apply the rules of IUPAC nomenclature to write the names and structure of organic compounds.
3. Classify hydrocarbons and write their structural formulas.
4. Explain hybridization with suitable examples.

1.1	**Basic concepts of organic chemistry** Classification of Hydrocarbon, structural representation of organic compound, complete, condensed and bond-line structural formula, dipole moment, bond order, bond length, types of functional groups, hybridization.	**[3 L]**
1.2	**Alkanes and cycloalkanes** **(A) Alkanes:** IUPAC nomenclature of branched and unbranched alkanes, Alkyl group, Classification of carbon atoms in alkanes. Isomerism in Alkanes, sources, methods of formation special reference to Wurtz and Wurtz-Fittig reaction Kolbe reaction and Corey-House reaction and decarboxylation of carboxylic acids). Physical properties and chemical reactions of alkanes. Mechanism of free radical halogenations of alkanes: orientation, reactivity &selectivity. **(B) Cycloalkanes:** Nomenclature, methods of formation, chemical reactions, Theory of strainless ring. The case of cyclopropane ring: banana bonds.	**[8 L]**
1.3	**IUPAC Nomenclature of organic compounds** Types of organic compounds, Functional group, Homologous series, IUPAC system for nomenclature, Nomenclature of poly functional compounds.	**[4 L]**
Module 2	**Stereochemistry & Preparation**	**[15 L]**

Learning Objective

- To study fundamentals of stereochemistry and few chemical preparations.

Learning Outcomes:

At the end of this module the learner will be able to

1. Define and identify the different types of isomers and their properties.
2. Sketch Flying-Wedge representation, Fisher Projection, sawhorse (perspective) formula, Newman projection.
3. Illustrate Interconversions of Projection and Perspective formula.
4. Summarize Conformations of n-butane, Eclipsed and Staggered form
5. Explain Baeyer's strain theory and its limitations
6. Judge D & L, R & S nomenclature of organic compounds.

7. Identify and write E & Z nomenclature in geometrical isomers. 8. Explain different types of organic reactions with their examples.		
2.1	**Stereochemistry** Isomerism: Optical activity, chiral and achiral molecules, representation of three-dimensional molecules- tetrahedral model, Flying-Wedge representation, Fischer Projection, sawhorse (perspective) formula, Newman projection, Conformations of n-butane, Eclipsed and Staggered form, Ring strain in small rings (Cyclopropane and cyclobutane), configurational isomerism, Optical isomerism of tartaric acid, enantiomers, diastereomers (Threo & Erythro), meso compounds, inversion retention and racemization; Geometrical isomerism: Alkene derivative & oximes, E & Z system of nomenclature; Relative and absolute configuration, sequence rules, D & L and R & S system of nomenclature	**[10 L]**
2.2	**Types of reactions:** Substitution, Addition, Elimination and Rearrangement with suitable examples. (Introductory)	**[5 L]**
Module 3	**Heterocyclic compounds and hydrocarbons**	**[15 L]**
Learning Objective • To study fundamentals and chemical reactions of heterocyclic compounds and hydrocarbons.		
Learning Outcomes: At the end of this module the learner will be able to 1. Recall and write structure, synthesis and chemical reactions of few heterocyclic compounds. 2. Recall and write structure, synthesis and chemical reactions of aromatic hydrocarbons. (benzene). 3. Explain Sulfonation, Nitration, Halogenation and Alkylation reaction. 4. Describe activating and deactivating substituent (i/o/m/p effect)		
3.1	**Heterocyclic compounds** Nomenclature, aromaticity and synthesis, properties, and resonance structures of Pyridine, Pyrrole, Furan, Thiophene	**[5 L]**

3.2	**Polynuclear hydrocarbon** Classification, aromaticity and synthesis or industrial preparation, properties, uses and resonance structures of Naphthalene, Anthracene and Phenanthrene	**[5 L]**
3.3	**Aromatic hydrocarbons** Method of preparation and chemical reactions of benzene: sulphonation, nitration, halogenation and alkylation, activating and deactivating substituents, orientation, ortho/para ratio, ipso effect.	**[5 L]**

List of Major Textbooks:

1. A textbook of Organic chemistry by Arun Bahl and B. S. Bahl, S. Chand & Company Pvt. Ltd.
2. Organic chemistry Vol. I and Vol. II by I.L. Finar (Longman group).
3. Textbook of Organic chemistry by P. L. Soni.
4. Organic chemistry by R. T. Morrison and Boyd Prentice Hall India.
5. Organic chemistry Vol. I & II by B. K. Sharma & S. K. Sharma; Goel Pub. House, Merut.
6. Organic reaction mechanism by Mukherji and Singh.
7. Fundamentals of Organic chemistry by Soloman, John Wiely
8. Vogel's qualitative organic analysis.
9. Organic Chemistry by L. G. Wade Jr. Prentice Hall
10. Stereochemistry conformation and mechanism by P. S. Kalsi. 6th edition, New age International.

e-Resources:

1. **https://courses.lumenlearning.com/suny-potsdam-organicchemistry/chapter/3-1-nomenclature-of-alkanes-related-structures/**
2. **https://courses.lumenlearning.com/suny-potsdam-organicchemistry/chapter/3-2-nomenclature-of-unsaturated-hydrocarbons/**
3. **https://courses.lumenlearning.com/suny-potsdam-organicchemistry/chapter/1-3-representing-structures/**
4. **https://courses.lumenlearning.com/suny-potsdam-organicchemistry/chapter/1-7-3d-structure/**
5. **https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/chapt5.htm**
6. **https://archive.nptel.ac.in/content/storage2/courses/104103071/pdf/mod4.pdf**

7. https://onlinecourses.nptel.ac.in/noc19_cy25/preview

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	2	3	4	5	6	7	8	9
1.	√	√	√			√		√	
2.	√	√	√			√		√	
3.	√	√	√			√		√	
4.	√	√	√			√		√	
5.	√	√	√			√		√	
6.	√	√	√			√		√	
7.	√	√	√			√		√	
8.	√	√	√			√		√	

SEMESTER I

Minor Course - I

COURSE NAME: Chemistry Minor Paper I

COURSE CODE: CHEMN-S1P1-2CR25 **[CREDITS - 02]**

Course learning outcome		
At the end of this course, Students will be able to 1. Explain different methods of purification and organic qualitative analysis. 2. Classify organic compounds and apply the rules of IUPAC nomenclature to write the names and structures of organic compounds. 3. Distinguish between different types of isomerism with examples. 4. Sketch Flying-Wedge representation, Fisher Projection, sawhorse (perspective) formula, Newman projection. 5. Define basic physical properties, Outline the fundamental concepts of atomic structure; Calculate quantum numbers and effective nuclear charge; 6. Interpret atomic spectrum and depict different orbitals in atoms. 7. Describe and compare theories of chemical bonding. 8. Classify the types of hybridization. 9. Apply the theories of chemical bonding for predicting the geometric structures of molecules. 10. Calculate bond order of different molecules.		
Module 1	**Basic Organic Chemistry I**	**[15 L]**
Learning Objective: • To familiarize the student with the fundamental concepts of organic and inorganic chemistry.		
Learning Outcomes: At the end of this module the learner will be able to 1. Explain different methods of purification and organic qualitative analysis. 2. Classify organic compounds and apply the rules of IUPAC nomenclature to write the names and structures of organic compounds. 3. Distinguish between different types of isomerism with examples. 4. Sketch Flying-Wedge representation, Fisher Projection, sawhorse (perspective) formula, Newman projection.		
1.1	**Organic Chemistry – Some Basic Principles and Techniques** General introduction, methods of purification, organic qualitative	**[8 L]**

	analysis, classification and IUPAC nomenclature of organic compounds.	
1.2	**Isomerism** Isomerism Types, Structural Isomerism: Chain, Positional, functional, metamerism, Tautomerism, Stereoisomerism, optical isomerism, Flying-Wedge representation, Fischer Projection, sawhorse (perspective) formula, Newman projection	**[7 L]**
Module 2	**General Chemistry I**	**[15 L]**
Learning Objective: • To make the students aware about some study basic properties of inorganic chemistry e.g. chemical kinetics and chemical bonding.		
Learning Outcomes: At the end of this module the learner will be able to 1. Define basic physical properties, Outline the fundamental concepts of atomic structure; Calculate quantum numbers and effective nuclear charge; 2. Interpret atomic spectrum and depict different orbitals in atoms. 3. Describe and compare theories of chemical bonding; classify the types of hybridization. 4. Apply the theories of chemical bonding for predicting the geometric structures of molecules. 5. Calculate bond order of different molecules.		
2.1	**Atomic Structure:** Rutherford atomic model, Bohr's theory and it's limitations, atomic spectrum of hydrogen atom, de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Quantum numbers and their significance, Shapes of s, p, d and f orbitals, Aufbau principle, Hund's rule, Pauli exclusion principle, Effective nuclear charge (Slater Rule).	**[7 L]**
2.2	**Chemical Bonding:** Definition of chemical bonds, Types of bonds – ionic, covalent, coordinate, metallic bonds. Valence Bond Theory, Concept of hybridization. Types of hybridization involving s, p, & d orbitals, VSEPR theory with examples, Basics of MO theory, MO – bonding, non-bonding, anti-bonding (Introductory).	**[8 L]**

List of Major Textbooks:

- A textbook of Organic Chemistry by Arun Bahl and B. S. Bahl, S. Chand & Company Pvt. Ltd.
- Organic chemistry Vol. I and Vol. II by I.L. Finar (Longman group).
- Organic chemistry by R. T. Morrison and Boyd Prentice Hall India.
- Organic chemistry Vol.I and Vol.II by B. K. Sharma, & S. K. Sharma Goel Pub. House, Merut.
- Concise Inorganic Chemistry by J. D. Lee, 5/E, Oxford University Press, Indian Eds.
- Basic Inorganic Chemistry by F. A. Cotton and G. Wilkinson, Wiley publication.
- Inorganic Chemistry by Shriver & Atkins, 4/E, Oxford University Press, Indian Eds.
- General and Inorganic Chemistry: Volume I by R. P. Sarkar, New Central Book Agency; 3rdRevised edition (1 July 2011), India.
- Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E.A. Keiter, R.L. Keiter, Pearson; 4th edition (1997).
- Inorganic Chemistry by Shriver, Atkins and Langford, Pubs: W H Freeman & Co (1994).
- Essence of chemical kinetics by Dr. Harichandra A. Parbat and Dr. Damodar V. Prabhu, Sara Publication, 1st edition, (2022).

e-Resources:

Module-1

1. **https://courses.lumenlearning.com/suny-potsdam-organicchemistry/chapter/3-1-nomenclature-of-alkanes-related-structures/**
2. **https://courses.lumenlearning.com/suny-potsdam-organicchemistry/chapter/3-2-nomenclature-of-unsaturated-hydrocarbons/**
3. **https://courses.lumenlearning.com/suny-potsdam-organicchemistry/chapter/1-5-isomerism/**
4. **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000656/M014409/LM/1456899473CHE_P1_M30_knowMore.pdf**

Module-2

5. **https://sathee.prutor.ai/jee-chemistry/atomic-structure/**
6. **Swayam with IITMadras : https://www.youtube.com/watch?v=ZVPrpvEg4_0**
7. **https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/95**

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	2	3	4	5	6	7	8	9
1.	√								
2.	√	√	√			√			
3.	√	√	√			√			
4.	√	√	√			√			
5.	√	√							
6.	√	√							
7.	√	√							
8.	√	√			√				
9.		√			√				
10.			√		√		√		

SEMESTER I
Multidisciplinary Course - I

COURSE NAME: General Chemistry I

COURSE CODE: CHEMDC-S1P1-4CR25 **[CREDITS - 04]**

Course learning outcome		
At the end of this course, Students will be able to 1. Define basic physical properties, outline the fundamental concepts of atomic structure; calculate quantum numbers and effective nuclear charge; interpret atomic spectrum and depict different orbitals in atoms. 2. Describe the periodic table; state the principal resemblances of elements within each main group of the periodic table; compare the trends in the properties of the elements in the periodic table. 3. Define and calculate different units of concentration of solution. 4. Define the significance of nanoscience and technology, including understanding nanostructures and their properties in various applications. 5. Discuss and analyse challenges and anticipate future prospects in nanotechnology		
Module 1	**Atomic Structure**	**[15 L]**
Learning Objective • To perceive basics of atomic structure.		
Learning Outcomes: At the end of this course, Students will be able to 1. Define basic physical properties, outline the fundamental concepts of atomic structure; calculate quantum numbers and effective nuclear charge; interpret atomic spectrum and depict different orbitals in atoms.		
1.1	Rutherford atomic model, Bohr's theory and it's application to H-atom, limitations, atomic spectrum of hydrogen atom, de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Aufbau principle, Hund's rule, Pauli exclusion principle, Effective nuclear charge (Slater Rule).	
Module 2	**Periodic properties**	**[15 L]**
Learning Objective • To learn basics of periodic properties.		
Learning Outcomes:		

At the end of this course, Students will be able to 1. Describe the periodic table; state the principal resemblances of elements within each main group of the periodic table; compare the trends in the properties of the elements in the periodic table.		
2.1	Long form of periodic table, general properties of period and group elements; variation of orbital energy with atomic number, Discussion of the general properties of the elements along the period and group (Atomic/Ionic radii, electronegativity, IE, EA energy), application of electronegativity, Pauling's scale of electronegativity, Diagonal relationship.	
Module 3	**Chemical Calculation**	**[15 L]**
Learning Objective ● To learn calculations of different concentration units of solution		
Learning Outcomes: At the end of this course, Students will be able to 1. Define and calculate different units of concentration of solution.		
3.1	Mole concept, Gram atomic weight, Gram molecular weight, Equivalent weight, Methods of expressing concentration of solutions: Molarity, Formality, Normality, Molality, mole fraction, % w/w, % w/v, %v/v, interconversion of units of concentration. Numericals. Titrations: Primary standard and secondary standard substances, criteria in selection of primary standard substances, calculation of preparation of standard solution (0.1N Succinic acid, 0.1N Oxalic acid, 0.1N KHP, 0.05N $K_2Cr_2O_7$) Problems.	
Module 4	**Introduction to Nanoscience and Technology**	**[15 L]**
Learning Objective ● To understand the foundational principles of nanoscience and technology, including nanostructures, properties, and classification. ● To learn the applications, challenges, and future prospects of nanomaterials, with a focus on innovation and technological advancements.		
Learning Outcomes: At the end of this course, Students will be able to 1. Define the significance of nanoscience and technology, including understanding		

	nanostructures and their properties in various applications. 2. Discuss and analyse challenges and anticipate prospects in nanotechnology	
4.1	Definition of Nanoscience and technology, History and scope, Nano-size and properties, Overview of nanostructures and nano-materials, classification, (cluster, colloid, nanoparticles, and nanostructures - Spheroid, Wire, Rod, Tube, and Quantum Dot), Application of nanomaterials, Nature: The best nanotechnologist, Challenges and future prospects.	

List of Major Textbooks:

1. Concise Inorganic Chemistry by J. D. Lee, 5/E, Oxford University Press, Indian Edition.
2. Basic Inorganic Chemistry by F. A. Cotton and G. Wilkinson, Wiley publication.
3. Inorganic Chemistry by Shriver & Atkins, 4/E, Oxford University Press, Indian Edition.
4. General and Inorganic Chemistry: Volume I by R. P. Sarkar, New Central Book Agency; 3rd Revised edition (1 July 2011), India.
5. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E.A. Keiter, R.L. Keiter, Pearson; 4th edition (1997).
6. Inorganic Chemistry by Shriver, Atkins and Langford, Pubs: W H Freeman & Co (Sd) (1994).
7. C. N. R. Rao, A. Muller, A. K. Cheetam, the Chemistry of Nanomaterials: Synthesis, Properties and Applications, Willey-VCH Verlag, Germany, 2005.
8. G. Cao, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press, London, 2004
9. Charles P. Poole and Frank J Owens, Introduction to Nano technology, Wiley Interscience, 2003. 5. Pradeep, T., A text of book of nanoscience and nanotechnology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
10. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
11. Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.

e-Resources:

1. **https://ncert.nic.in/textbook/pdf/iesc104.pdf**
2. **https://ncert.nic.in/textbook/pdf/kech102.pdf**
3. **https://archive.nptel.ac.in/content/storage2/courses/104103019/module1/lec1/1.html**

4. https://courses.lumenlearning.com/chemistryformajors/chapter/the-periodic-table-4/
5. https://courses.lumenlearning.com/suny-mcc-introductorychemistry/chapter/formula-mass-and-mole-concept-from-che100/
6. https://archive.nptel.ac.in/courses/103/103/103103165/
7. https://archive.nptel.ac.in/courses/118/107/118107015/
8. https://archive.nptel.ac.in/courses/118/104/118104008/

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	2	3	4	5	6	7	8	9
1.	√	√	√			√	√	√	
2.	√	√	√			√	√	√	
3.	√	√	√			√	√	√	
4.	√	√	√				√	√	
5.	√	√	√			√	√	√	

SEMESTER I

COURSE NAME: Chemistry Practical –I & Chemistry Practical –II

COURSE CODE: CHEMJ-S1PR1-1CR25 & CHEMJ-S1PR2-1CR25 **[CREDITS – 1+1]**

Course learning outcome		
At the end of this course, Students will be able to 1. Demonstrate practical knowledge of qualitative analysis of inorganic salts. 2. Perform standardization and various preparation of standard solutions.		
Learning Objective • To equip students with the knowledge of inorganic qualitative approach of salts. • To make students understand the methods of preparation of standard solutions and quantitative approach.		
A	**Inorganic qualitative analysis (Chemistry Practical –I) (CHEMJ-S1PR1-1CR25)**	
	CHLORIDES: Cu^{+2}, Fe^{+3}, Mn^{+2}, Co^{+2}, Ni^{+2}, Ba^{+2}, Sr^{+2}, Na^{+}, K^{+}, NH_4^{+} **BROMIDES** : Sr^{+2}, Na^{+}, K^{+}, NH_4^{+} **IODIDE** : K^{+} **NITRATE** : Pb^{+2}, Co^{+2}, Ni^{+2}, Ba^{+2}, Sr^{+2}, Na^{+}, K^{+}, NH_4^{+} **SULPHIDE** : Zn^{+2}, Sb^{+3} **SULPHATE** : Cu^{+2}, Al^{+3}, Fe^{+2}, Zn^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}, Mg^{+2}, Na^{+}, K^{+}, NH_4^{+} **CARBONATE**: Cu^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}, Zn^{+2}, Ca^{+2}, Ba^{+2}, Sr^{+2}, Mg^{+2}, Na^{+}, K^{+}, NH_4^{+} **PHOSPHATE**: Cu^{+2}, Al^{+3}, Fe^{+3}, Zn^{+2}, Mn^{+2}, Ba^{+2}, Sr^{+2}, Mg^{+2}, Na^{+}, K^{+}, NH_4^{+} **OXIDE** : As^{+3}, Sb^{+3}, Zn^{+2} **CHROMATE**: Na^{+}, K^{+}	
B	**Preparation of standard solution (by students) of following (Chemistry Practical –II) (CHEMJ-S1PR2-1CR25)**	
	1. 0.1N succinic acid against NaOH 2. 0.1N succinic acid against KOH 3. 0.1N KHP against NaOH 4. 0.1N KHP against KOH 5. 0.01N $Na_2S_2O_3$ against I_2 solution 6. 0.01N $Na_2S_2O_3$ against $K_2Cr_2O_7$ solution	

	7. 0.1N $H_2C_2O_4.2H_2O$ against $KMnO_4$ solution 8. 0.1N $K_2Cr_2O_7$ against $FeSO_4.7H_2O$ solution 9. 0.1N $K_2Cr_2O_7$ against $FeSO_4$ $(NH_4)_2SO_4.10H_2O$ solution 10. 0.1N Na_2CO_3 against HCl solution	

List of Major Textbooks:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
2. Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1.	√	√		√	√		√	√	
2.	√	√		√			√	√	

SEMESTER I

COURSE NAME: Chemistry Practical – Minor I

COURSE CODE: CHEMN-S1PR1-2CR25 **[CREDITS - 02]**

Course learning outcome		
At the end of this course, Students will be able to 1. Demonstrate practical knowledge of qualitative analysis of organic substance. 2. Perform various analytical methods of volumetric analysis especially acid-base and redox titration.		
Learning Objective: • To equip students with the knowledge of organic substances and it's spotting. • To make students understand the methods of volumetric exercises and quantitative approach.		
A	**Organic Qualitative Analysis**	
	Acid: Benzoic acid, Phthalic acid and Succinic acid **Phenol:**α-Naphthol, β-Naphthol, Resorcinol **Base:** Aniline, p-toluidine **Neutral:** **Ketone:** Acetone, Acetophenone **Ester:** Methyl acetate, Methyl salicylate **Carbohydrate:** Glucose, Fructose **Hydrocarbon:** Naphthalene **Halogenated Hydrocarbon:** Carbon tetrachloride, Chloro benzene, **Nitro compound:** Nitro benzene, m-dinitro benzene **Amide:** Urea **Anilide:** Acetanilide	
B	**Volumetric exercise**	
	HNO_3 NaOH $H_2C_2O_4{\cdot}2H_2O$ H_2SO_4 $NaHCO_3$ HNO_3 $KMnO_4$ $H_2C_2O_4{\cdot}2H_2O$ KOH / NaOH $KMnO_4$ $FeSO_4{\cdot}7H_2O$ $K_2Cr_2O_7$ $H_2C_2O_4{\cdot}2H_2O$ $KMnO_4$ $FeSO_4{\cdot}7H_2O$	

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1.	√	√		√	√		√	√	
2.	√	√		√			√	√	

SEMESTER I

COURSE NAME: Chemistry Lab Operations and preparation of cosmetics

COURSE CODE: CHESEC-S1P1-2CR25 **[CREDIT - 02]**

Course learning outcome	
At the end of this course, Students will be able to 1. Illustrate the handling of glassware such as burette and pipette and weighing machine. 2. Illustrate the preparation of standard solutions, common soaps and detergent. 3. Demonstrate and handling of fire-extinguisher. 4. Prepare various types of cosmetics in laboratory.	
Learning Objective	
• To equip students with the knowledge of handling of glassware and chemicals. • To make students understand the methods of preparation of standard solutions, soaps and detergents. • To equip students with the knowledge of preparation of various types of cosmetics.	
1.1	**Chemistry Lab Operations** 1. Demonstration and handling of fire-extinguisher. 2. Calibration and handling of burette and pipette. 3. Handling, precautions and calibration of weighing machine. 4. Storage and disposal of chemicals: demonstration and handling. 5. Preparation technique of standard solutions. 6. Laboratory preparation of standard soap. 7. Laboratory preparation of liquid soap. 8. Laboratory preparation of detergent.
1.2	**Preparation of cosmetics** 1. Hair cream 2. Hair oil 3. Chemical hair dye 4. Natural hair dye 5. Hair remover 6. Lip balm 7. Hair fixative 8. Face cream 9. Liquid shampoo
List of Major Textbooks:	

1. Hazards in Chemical Laboratory - G. D. Muir.
2. Research Methodology –C. R. Kothari, New Age International Publishers, New Delhi (2004).
3. Manufacture, Storage and Import of Hazardous Chemicals Rules -1989.
4. Laboratory safety for chemistry students – R. H. Hill, D. C. Finster, Wiley (2016).
5. Introduction to cosmetic formulation and technology by Gabriella Baki and K.S. Alexander, Wiley (2015).
6. Cosmetic and Toiletry formulations by Ernest W. Flick, Noyes Publications (1992).
7. Cosmetics by Chandrakant Pathak, Bimal Prakashan.

Mapping of CLOs and PSOs:

Course Learning Outcomes	Programme Specific Outcomes								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1.	√	√			√	√	√	√	
2.	√	√				√	√	√	
3.	√	√				√			
4.	√	√				√	√	√	