



Sir P. T. Sarvajani College of Science

Autonomous

Affiliated to Veer Narmad South Gujarat University, Surat

Re-Accredited 'A+' with CGPA 3.35

SYLLABUS

FOR

SEM VI

Programme: B.Sc.

Course: Chemistry

Academic year

2026-27

(NEP-2020)

(To be effective from June, 2026)



B.Sc. SEMESTER VI

Major Course - XIV

COURSE NAME: Chemistry Paper - XIV

COURSE CODE: CHEMJ-S6P14-2CR26 [CREDITS - 02]

Course learning outcome

At the end of this course, Students will be able to

1. Identify and describe symmetry elements and operations present in simple molecules.
2. Classify molecules into appropriate point groups with examples such as H_2O , NH_3 , PF_5 , C_6H_6 , CH_4 , SF_6 , etc.
3. Construct & interpret multiplication tables for point groups like C_{2v} , C_{2h} and C_{3v} .
4. Describe the classification, structures and bonding of boron hydrides, applying Wade's rule to predict and analyse their stability.
5. Explain and illustrate the structures and bonding patterns of specific boron hydrides such as B_4H_{10} , B_5H_9 and $[\text{B}_{12}\text{H}_{12}]^{2-}$ etc.
6. Describe the concepts and factors affecting the stability of metal complexes, stability constants, lability, and inertness in coordination compounds.
7. Apply the concept of stability constants to compare the stability of different metal complexes and explain the mechanism of substitution reactions in square planar complexes.
8. Explain the theories of the Trans effect, including Electrostatic Polarization Theory and π -Bond Theory, and compare their significance.

Module 1

Molecular Symmetry

[15L]

Learning Objective:

- To familiarize the student with an overview of symmetry elements, symmetry operations, point groups and multiplication tables.

Learning Outcomes:

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

1. Identify and describe symmetry elements and operations present in simple molecules.
2. Classify molecules into appropriate point groups with examples such as H_2O , NH_3 , PF_5 , C_6H_6 , CH_4 , SF_6 , etc.



3. Construct & interpret multiplication tables for point groups like C_{2v} , C_{2h} and C_{3v} .		
1.1	Molecular Symmetry Introduction and importance of symmetry, symmetry elements and symmetry operations, classification of molecules into symmetry point Groups, point Group of simple molecules like CO_2 , HCl , H_2O , NH_3 , BF_3 , $[PtCl_4]^{-2}$, PF_5 , C_6H_6 , $C_5H_5^-$, CH_4 , SF_6 , bromobenzene (C_6H_5Br), cyclobutane, boric acid (H_3BO_3), cis- and trans- Dichloroethylene ($C_2H_2Cl_2$), staggered and eclipsed Ethane (C_2H_6). Law of Multiplications, Construction of multiplication table for C_{2v} , C_{2h} and C_{3v} point groups	[15L]
Module 2	Boron Hydrides and Thermodynamic & Kinetic aspects of Metal Complexes	[15L]
Learning Objective: - To enable students to understand the classification, structure, and bonding of boron hydrides using Wade's rule - To acquaint the students with the principles and concepts of thermodynamic & kinetic aspects of metal complexes		
Learning Outcomes: At the end of this module the learner will be able to - Describe the classification, structures and bonding of boron hydrides, applying Wade's rule to predict and analyse their stability. - Explain and illustrate the structures and bonding patterns of specific boron hydrides such as B_4H_{10}, B_5H_9 and $[B_{12}H_{12}]^{2-}$ etc. - Describe the concepts and factors affecting the stability of metal complexes, stability constants, lability, and inertness in coordination compounds. - Apply the concept of stability constants to compare the stability of different metal complexes and explain the mechanism of substitution reactions in square planar complexes. - Explain the theories of the Trans effect, including Electrostatic Polarization Theory and π-Bond Theory, and compare their significance.		
2.1	Boron Hydrides Boron hydride and its classification, Wade's rule, preparation,	[7L]



	properties, structure and bonding in diborane, tetra borane (10), penta borane (9), penta borane (11), hexa borane (10) and dodeca borane (12) anion	
2.2	Thermodynamic & Kinetic aspects of Metal Complexes A brief out-line of thermodynamic stability of metal complexes, stability constant, factors affecting stability of metal complexes, liability and inertness, factors affecting liability of metal complexes, substitution reaction in square planar complexes, Trans effect, theories of Trans effect (1) Electrostatic Polarisation theory (2) II-Bond theory, uses of Trans effects, VBT and CFT.	[8L]

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. Application of group theory to chemistry by P. K. Bhattacharya, Himalaya Publishing House, Mumbai.
8. Application of group theory by K. Veera Reddy.
9. Selected topics in inorganic chemistry by Bhal, Tuli and Madan.

e-Resources:

Module 1:

1. NPTEL-NOC: <https://www.youtube.com/watch?v=ClDvdv4BRhQ>
2. <http://www.digimat.in/nptel/courses/video/104101094/L01.html>
3. <http://www.digimat.in/nptel/courses/video/104101094/L60.html>



4. Swayam Prabha: <https://www.youtube.com/watch?v=AUDW95ENgC8>

Module 2:

1. Swayam Prabha: https://www.youtube.com/watch?v=_NG_kDe5dho
2. Swayam Prabha: <https://www.youtube.com/watch?v=dFI0LcqSboQ>
3. ePathshala:1456899566CHE_P3_M5_etext.pdf<https://share.google/DV7lsjLGoqolHixUs>
4. CH-08 Aryabhata: https://youtu.be/pAz5_2YZ440?si=am5k_oXBanvh94Z_
5. SwayamPrabha: <https://www.youtube.com/watch?v=Q5pBe4VFz4M>
6. https://www.swayamprabha.gov.in/program/archive_he/4

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.	√	√	√			√			



B. Sc. SEMESTER VI

Major Course - XV

COURSE NAME: Chemistry Paper - XV

COURSE CODE: CHEMJ-S6P15-2CR26 [CREDITS – 02]

Course learning outcome

At the end of this course, students will be able to

1. Describe the structural changes that occur during C-to-C and C-to-N migrations.
2. Predict the product of a given molecular rearrangement reaction based on the substrate structure.
3. Explain the isoprene rule and the special isoprene rule in the context of terpenoid structure.
4. Demonstrate the general methods used to determine the structure of terpenoids.
5. Define dyes, chromophore and auxochromes.
6. Classify dyes based on source, constitution and application.
7. Define drugs and different terms related to drugs.
8. Classify drugs with definition and examples.

Module 1

Molecular rearrangements and Terpenoids

[15L]

Learning Objectives:

- To understand, interpret, and evaluate the mechanisms of molecular rearrangements involving carbon-to-carbon and carbon-to-nitrogen migrations, specifically illustrated by Wagner–Meerwein, Pinacol–Pinacolone, Hofmann, Curtius, and Beckmann rearrangements.
- To understand the occurrence, classification, and structural principles of terpenoids, including the application of the isoprene rule, and to analyze the structure of specific compounds such as α -Pinene and Citral using analytical and synthetic evidence.

Learning Outcomes:

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

1. Describe the structural changes that occur during C-to-C and C-to-N migrations.
2. Predict the product of a given molecular rearrangement reaction based on the substrate structure.
3. Explain the isoprene rule and the special isoprene rule in the context of terpenoid structure.



4. Demonstrate the general methods used to determine the structure of terpenoids.		
1.1	Molecular Rearrangements Mechanism of rearrangements involving C to C migrations as illustrated by Wagner – Meerwein and Pinacol-Pinacolone rearrangements. Mechanism of rearrangements involving C to N migrations as illustrated by Hoffmann, Curtius, and Beckmann rearrangements.	[8L]
1.2	Terpenoids (Isoprenoids) Their occurrence, classification, isoprene and special isoprene rule, general methods to determine their structure, analytical and synthetic evidences for the structure of α -Pinene & Citral.	[7L]
Module 2	Synthetic Dyes and Drugs	[15L]
Learning Objectives: - To familiarize students with basic concepts of dyes and their classification. - To study basic concepts, classification and different terms related to drugs. - To study definition and examples of different types of drugs.		
Learning Outcomes: At the end of this module, the learner will be able to - Define dyes, chromophore and auxochromes. - Classify dyes based on source, constitution and application. - Define drugs and different terms related to drugs. - Classify drugs with definition and examples.		
2.1	Synthetic Dyes: Definition and difference between dyes and pigments, classification of dyes, color and constitution – Witt's theory, synthesis and uses of Crystal violet, Indigo, Alizarin, Phenolphthalein, Eriochrome Black-T, Congo red, Bismarck brown, Methylene blue, Tartrazine.	[8L]
2.2	Synthetic Drugs Classification, based on pharmacological action, synthesis and uses of Amylnitrate, Pyrimethamine, Sulphapyrimidine, Diazepam, Lidocaine, Chlorpropamide, Dapsone, Isoniazide, Ibuprofen, 5-	[7L]



Fluoro Uracil.	
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List of Major Textbooks:

1. Mechanism and Structure in organic chemistry-Goulde. S.
2. Reaction mechanism in organic chemistry by Mukherjee & Singh
3. Principles of reaction mechanism in organic chemistry by Dharmaraha& Chawla
4. Organic reaction mechanism by Bansal Tata Mac. Hill
5. Organic Chemistry (Vol I & II) 6thEdn, I. L. Finar.
6. Organic Chemistry by Hendrickson, Cram & Hammond
7. Organic Chemistry by Brown R. F.
8. Organic Chemistry by Solomon W. Graham
9. Principles of Organic Synthesis- R. O. C. Norman
10. Basic Principles of Organic chemistry, by R. Y. Caserio, W. A. Benjamin
11. May's Chemistry of synthetic Drugs by Dyson.
12. Chemistry of drugs, Ener and Caldwell
13. Synthetic drugs by Tyagi and Yadav.
14. Chemistry of synthetic Dyes Vol. I & II by Venkatraman
15. Synthetic Organic Chemistry by O. P. Agarwal
16. Synthetic Dyes by Chatwal &Anand
17. Chemistry of synthetic Dyes by I. G. Vashi
18. Organic Chemistry by Morrison and Boyd.
19. Chemistry of organic Natural Product Vol. I & II by O. P. Agarwal.
20. Chemistry of synthetic drugs by Trivedi
21. Principles of Medicinal Chemistry Vol. I & II by S. S. Kadam, K. R. Mahadik, K. G. Bothara (NiraliPrakashan)
22. Medicinal Chemistry by Asuthoshkar 4/e
23. Organic reactions & their mechanism by P. S. Kalsi, New age international publishers.

e-Resources:

1. <https://archive.nptel.ac.in/content/storage2/courses/104103022/download/module8.pdf>
2. <https://globalresearchonline.net/journalcontents/v27-2/45.pdf>
3. <https://textileengineering.net/synthetic-dyes-properties-types-application/>
4. <https://egyankosh.ac.in/bitstream/123456789/38341/1/Unit-9.pdf>



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.	√	√							



B.Sc. SEMESTER VI

Major Course- XVI

COURSE NAME: Chemistry Paper - XVI

COURSE CODE: CHEMJ-S6P16-2CR26 [CREDITS - 02]

Course learning outcome

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

1. Define fundamental concepts such as electrode, half-cell, cell potential, Standard Electrode Potential (E°), and the Electrochemical series.
2. Explain the principles of the electrochemical processes occurring at the anode and cathode, and the function of the salt bridge.
3. Describe the construction, working principle, and applications of different types of electrodes, including the Standard Hydrogen Electrode (SHE), Calomel electrode, and Ag-AgCl electrode.
4. Determine the single electrode potential and the spontaneity of a cell reaction from the measured EMF values.
5. Classify electrochemical cells into Chemical cells and Concentration cells (electrode and electrolyte) and discuss the concept and elimination of Liquid Junction Potential (LJP).
6. Derive the equations for the EMF of Chemical and Concentration cells, both with and without transference.
7. Relate Free Energy change (ΔG), Electrical Energy, and cell EMF to predict the spontaneity of cell reactions, and establish the relationship between ΔG° and the equilibrium constant (K). Calculate thermodynamic parameters (ΔG , ΔH , ΔS) of a cell reaction from EMF measurements and its temperature coefficient.
8. Calculate, analyse and solve numerical problems based on above topics of electrochemistry.
9. Analyze the working principles, materials, and applications of advanced energy storage devices like Li-ion and Li-Polymer Batteries.
10. Describe the components used in spectrophotometer and working of single and double beam spectrophotometer.
11. Explain the terms involved in Beer's Law and deviation from Beer's Law.
12. Explain the methods used in analysis of unknown solution and solve the problems based on quantitative analysis.



13. Describe the terms involved in acid-base titration and theory of acid-base indicators.
14. Calculate pH at different stages of acid-base titration.

Module 1	Physical Chemistry II	[15 L]
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Learning Objective:

- To equip students with knowledge of concepts and principles of electrochemistry and thermodynamics.

Learning Outcomes:

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

1. Define fundamental concepts such as electrode, half-cell, cell potential, Standard Electrode Potential (E°), and the Electrochemical series.
2. Explain the principles of the electrochemical processes occurring at the anode and cathode, and the function of the salt bridge.
3. Describe the construction, working principle, and applications of different types of electrodes, including the Standard Hydrogen Electrode (SHE), Calomel electrode, and Ag-AgCl electrode.
4. Determine the single electrode potential and the spontaneity of a cell reaction from the measured EMF values.
5. Classify electrochemical cells into Chemical cells and Concentration cells (electrode and electrolyte) and discuss the concept and elimination of Liquid Junction Potential (LJP).
6. Derive the equations for the EMF of Chemical and Concentration cells, both with and without transference.
7. Relate Free Energy change (ΔG), Electrical Energy, and cell EMF to predict the spontaneity of cell reactions, and establish the relationship between ΔG° and the equilibrium constant (K). Calculate thermodynamic parameters (ΔG , ΔH , ΔS) of a cell reaction from EMF measurements and its temperature coefficient.
8. Calculate, analyse and solve numerical problems based on above topics of electrochemistry.
9. Analyze the working principles, materials, and applications of advanced energy storage devices like Li-ion and Li-Polymer Batteries.

1.1	Basics Of Electrode Electrochemical series (Reduction series), definition of electrode, half-cell and cell, single electrode potential, sign of electrode	[7 L]
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	potential, standard electrode potential (oxidation and reduction potential), Electrochemical process, Galvanic cell with example of Daniel cell, EMF of a cell and its measurements, Different types of reversible electrodes, determination of single electrode potential, Calculation of standard EMF of cell and Determination of cell reaction, Standard Hydrogen Electrode(SHE), Calomel electrode and Ag–AgCl electrode. Numerical problems.	
1.2	Classification Of Electrochemical Cell & Thermodynamics Classification of Chemical and concentration cell, electrode and electrolyte concentration cell, Concept of liquid junction potential (LJP), Use of salt bridge in elimination of LJP, Derivation of equation of Chemical & concentration cell with and without transference. Free energy change and Electrical energy, Prediction of spontaneity of cell reaction, Relation of standard free energy change with equilibrium constant, Temperature coefficient of EMF of a cell, Entropy change and Enthalpy change of cell reaction. Li- ion Battery, Li- Polymer Battery, Numerical problems.	[8 L]
Module 2	Spectroscopy and Acid-Base Titration	[15 L]
Learning Objective: To study basic concepts, principles and methods involved in spectroscopy and acid-base titration		
Learning Outcomes: At the end of this module, the learner will be able to - Describe the components used in spectrophotometer and working of single and double beam spectrophotometer. - Explain the terms involved in Beer's Law and deviation from Beer's Law. - Explain the methods used in analysis of unknown solution and solve the problems based on quantitative analysis. - Describe the terms involved in acid-base titration and theory of acid-base indicators. - Calculate pH at different stages of acid-base titration.		
2.1	Spectroscopy Types of spectrum, introduction of electromagnetic radiation, components of spectrophotometer-sources, grating and prism as	[10 L]



	dispersing device, sample handling, detectors- Photo tube, photomultiplier tube, block diagram and working of single beam and double beam spectrophotometer, terms involved in Beer's law (no derivation), causes of deviation from Beer's law, analysis of unknown by calibration curves method, standard addition method, and ratio method. Determination of Cu^{+2}, Fe^{+3}, NO_2^- using spectrophotometer. (Only principles - no detailed method), problems based on quantitative analysis.	
2.2	Acid Base Titration Definition of terms for titrant, titrand, analyte, end point and equivalence point, selection of proper indicators, calculation of pH at different stages of titrations of monobasic and dibasic acid with strong base, construction of titration curve, titration of carbonate mixture, problems	[5 L]

List of Major Textbooks:

1. An Introduction to Electro chemistry by S. Glasstone
2. Electrochemistry by B. K. Sharma
3. Modern Electrochemistry by J'om Bockris and Reddy
4. Electrochemistry by Carl H Hamann
5. Electrochemistry by Praveen Tyagi
6. Basic concept in Electrochemistry by Dr. Bhatu Shivaji Desale
7. Electrochemistry Principles, Methods, and Applications by Christopher M A Brett and Ana Maria Oliveira Brett.
8. Fundamental of Electrochemistry by V. S. Bagotsky
9. Physical chemistry by Gurdeepraj
10. Physical chemistry by Puri, Pathania, Sharma
11. Essential of Physical chemistry by Bahl and Bahl
12. Physical chemistry by Negi and Anand
13. Physical chemistry by K. L. Kapoor Vol-5.
14. Physical chemistry by Baliga, Dhavale and Zaveri Vol1-3.
15. Introduction to Spectroscopy; By Donald L. Pavia, Gary M. Lampman, George



- S. Kriz, Vyvyan, Fourth edition, Published by Brooks cole.
16. Spectroscopic Methods in Organic Chemistry; By D.H Williams, I. Fleming, Sixth edition, Published by Tata McGraw-Hill Education.
 17. Spectroscopy of Organic Compounds; By P S Kalsi, Sixth edition, New Age International Publisher.
 18. Organic Spectroscopy: Principles and Applications; By Jag Mohan, second edition, Published by Alpha Science International Ltd.
 19. Basic Principles of Spectroscopy; By Raymond Chang, Published by McGraw-Hill Inc.
 20. Elementary Organic Spectroscopy; By Y R Sharma, S. Chand &Company Pvt. Ltd.

e-Resources:

1. <https://nptel.ac.in/courses/104106137>.
2. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/116.
3. https://mlsu.ac.in/econtents/688_uv-visible%20Spectroscopy.pdf
4. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004201521035685ranvijay_engg_uv_and_visible_spectroscopy.pdf
5. [https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Physical_Methods_in_Chemistry_and_Nano_Science_\(Barron\)/04%3A_Chemical_Speciation/4.04%3A_uv-visible_Spectroscopy](https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Physical_Methods_in_Chemistry_and_Nano_Science_(Barron)/04%3A_Chemical_Speciation/4.04%3A_uv-visible_Spectroscopy)
6. <https://www.sciencedirect.com/topics/materials-science/uv-visible-spectroscopy>
7. <https://www.ramauniversity.ac.in/online-study-material/pharmacy/bpharma/isemester/pharmaceuticalanalysis-i/lecture-8.pdf>
8. https://chem.libretexts.org/Ancillary_Materials/Demos_Techniques_and_Experiments/General_Lab_Techniques/Titration/Acid-Base_Titrations

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.	✓								
11.	✓								
12.	✓	✓	✓				✓		
13.	✓								
14.	✓	✓	✓				✓		



B. Sc. SEMESTER VI

Minor Course - VI

COURSE NAME: Chemistry Minor Paper - VI

COURSE CODE: CHEMN-S6P6-2CR26 [CREDITS – 02]

Course learning outcome

At the end of this course, students will be able to

1. Describe the function and purpose of ingredients used in cosmetic formulations
2. Illustrate the preparation techniques for selected cosmetics such as cold cream, shampoo, or hair dye.
3. Explain the raw materials, chemical ingredients, and apparatus used in the small-scale preparation of listed consumer products.
4. Demonstrate the step-by-step process of preparing safety matches, naphthalene balls, wax candles, shoe polish, writing/ fountain pen ink, chalk crayons, plaster of paris
5. Summarize the health and environmental impacts of noise and oil pollution.
6. Apply knowledge to identify pollution sources in their locality.
7. Classify surface-active agents.
8. Analyse detergent labels to classify ingredients as surfactants, builders, or additives.

Module 1	Chemistry of cosmetics and perfumes and Small scale preparations	[15L]
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Learning Objectives:

- To understand the chemical composition, preparation methods, and applications of various cosmetic and perfume products, as well as the role and significance of essential oils in the cosmetic industry.
- To understand and apply the principles of formulation, handling, and small-scale manufacturing techniques in the preparation of commonly used chemical-based consumer products, while emphasizing safety, sustainability, and practical skills.

Learning Outcomes:

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

1. Describe the function and purpose of ingredients used in cosmetic formulations
2. Illustrate the preparation techniques for selected cosmetics such as cold cream,



shampoo, or hair dye.		
3. Explain the raw materials, chemical ingredients, and apparatus used in the small-scale preparation of listed consumer products.		
4. Demonstrate the step-by-step process of preparing safety matches, naphthalene balls, wax candles, shoe polish, writing/ fountain pen ink, chalk crayons, plaster of paris		
1.1	Chemistry of cosmetics and perfumes A general study including preparation and uses of the following: Hair dye, hairspray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail-enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmine, Civetone, Muscone.	[8 L]
1.2	Small scale preparation of (1) Safety matches (2) Naphthalene balls (3) Wax candles (4) Shoe polish (5) Writing/ fountain pen ink (6) Chalk crayons (7) Plaster of Paris	[7L]
Module 2	Environmental pollution and Detergents	[15L]
Learning Objectives: - To identify key terms such as greenhouse effect, ozone depletion, acid rain. - To describe how pollution impacts the environment and human health. - To recall the definition and types of detergents. - To demonstrate understanding by comparing detergent formulations for different cleaning applications.		
Learning Outcomes: At the end of this module, the learner will be able to - Summarize the health and environmental impacts of noise and oil pollution. - Apply knowledge to identify pollution sources in their locality. - Classify surface-active agents. - Analyze detergent labels to classify ingredients as surfactants, builders, or additives.		
2.1	Environmental pollution	[8 L]



	Introduction, types of Pollutions (1) Gaseous pollution in air, Acid rain, Greenhouse Effect and ozone depletion (2) Radiation pollution cause, effect and control, (3) Noise Pollution and their effect and control (4) Oil pollution and their control.	
2.2	Detergents Introduction, Principles of detergency, classification of surface-active agents, Anionic detergents, Cationic detergents, Non-ionic detergents, Amphoteric detergents, Suds regulators, Builders and Additives.	[7 L]

List of Major Textbooks:

1. Shreve Chemical Process Industries 5 ed. George. T. Austin. Mag. Hill. Book Agency
2. Reigel's Industrial Chemistry Ed. By James A. Kent.
3. Unit Process in Organic Synthesis by D. H. Groggins.
4. The Chemical Process Industries by R. Norris Shreve; McGraw-Hill Book Company, Ltd.
5. An Introduction to Industrial Chemistry by Peter Wiseman, Applied Science Pub. Ltd. London.
6. Industrial Chemistry by Clerk Ranken; Andesite Press.
7. Industrial Chemistry by B. K. Sharma Goel Pub.
8. Environmental Chemistry by H. Kaur.

e-Resources:

1. https://www.bspublications.net/downloads/0537db29d5dac8_Cosmetics%20A%20Practical%20manual_ch-1.pdf
2. <https://homepages.gac.edu/~sbur/CHE251/perfumes.pdf>
3. <https://archive.nptel.ac.in/content/storage2/courses/105105048/M10L12.pdf>
4. [https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Chemistry_for_Changing_Times_\(Hill_and_McCreary\)/21%3A_Household_Chemicals/21.02%3A_Synthetic_Detergents](https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Chemistry_for_Changing_Times_(Hill_and_McCreary)/21%3A_Household_Chemicals/21.02%3A_Synthetic_Detergents)



Mapping of COs and POs

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



B.Sc. SEMESTER VI

Major Practical Course – XII

COURSE NAME: Chemistry Practical –XII

COURSE CODE: CHEMJ-S6PR12-2CR26 [CREDITS -02]

Course Learning Objective

Learning Objectives:

- To equip students with the knowledge of methods of inorganic quantitative estimation by gravimetry.
- To make students understand the methods of volumetric exercises and quantitative approach.

Course Learning Outcomes

Learning outcomes:

At the end of the course, the students will be able to

1. Perform gravimetric estimations of metal ions such as Fe^{2+} , Ba^{2+} , and Al^{3+} and accurately determining their amount.
2. Analyze alloys such as Brass and German silver, estimating their composition by a combination of gravimetric (Zn^{2+} , Ni^{2+}) and volumetric (Cu^{2+} by iodometric) methods.
3. Apply different volumetric measurement techniques to estimate purity and composition of various salts.

INORGANIC GRAVIMETRIC & VOLUMETRIC ANALYSIS

GRAVIMETRIC ESTIMATION

1. Fe^{+2} as Fe_2O_3 from $\text{Fe}(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$
2. Ba^{+2} as BaSO_4 from $\text{BaCl}_2 + \text{FeCl}_3$
3. Al^{+3} as Al_2O_3 from $\text{Al}_2(\text{SO}_4)_3 + \text{CuSO}_4$

ESTIMATION OF ALLOY

1. Brass-

Zinc as $\text{Zn}_2\text{P}_2\text{O}_7$ (gravimetrically) & Copper by iodometrically (volumetric)

2. German silver -

Nickel as $\text{Ni}(\text{DMG})_2$ (gravimetrically) & Copper by iodometrically (volumetric)



VOLUMETRIC EXERCISE

1. To determine the percentage purity of potassium acid phthalate.
2. To determine the amount of Ammonium sulphate in the given solution
3. To determine the amount of Ferric by EDTA.
4. To determine the amount of Chromium by EDTA.
5. To determine the amount of Nickel with Magnesium by EDTA.
6. To determine the amount of Chloride by Mohr's method OR Absorption indicator.
7. To determine the amount of Bromide by Vohlard's method OR Absorption indicator.
8. To determine the percentage purity of NaNO_2 / KNO_2 .

List of Major Textbooks:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).
3. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
4. 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.		√		√	√	√	√	√	
3.		√		√	√	√	√	√	



B.Sc. SEMESTER VI

Major Practical Course – XIII

COURSE NAME: Chemistry Practical –XIII

COURSE CODE: CHEMJ-S6PR13-2CR26 [CREDITS -02]

Course Learning Objective

Learning Objective:

- To equip students with the knowledge of performing organic preparation.

Course learning outcome

Learning outcome:

At the end of this course, students will be able to

- Demonstrate proficiency in performing organic preparation

ORGANIC SEPARATION

Separation of binary mixture, identification of the components and their crystallization, preparation of one derivative and its purification:

NEUTRAL	ACID	Benzoic acid, Salicylic acid, Phthalic acid, Cinnamic acid, Phenyl acetic acid
	BASE	<i>o</i> - Nitroaniline, <i>m</i> - Nitroaniline, <i>p</i> - Nitroaniline, Aniline, <i>p</i> - Toluidine, <i>p</i> - Chloroaniline, Dimethylaniline, Diethylaniline, Diphenylamine (Not with Neutral)
	PHENOL	α - naphthol, β - naphthol, <i>o</i> - Nitro Phenol
	Aldehyde	Benzaldehyde
	Ketone	Acetone, Methyl Ethyl ketone, Acetophenone
	Ester	Methyl acetate, Ethyl acetate,
	Alcohol	Methanol, Ethanol
	Hydrocarbon	Toluene, Anthracene, Naphthalene, Diphenyl, anthraquinone
	Nitro Hydrocarbon	Nitrobenzene, <i>m</i> - Dinitro benzene
	Halogenated hydrocarbon	Chloroform, Chlorobenzene, Bromobenzene, <i>p</i> - Dichlorobenzene
	Amide	Benzamide
	Anilide	Acetanilide

**List of Major Textbooks:**

1. Vogel's Practical Organic Chemistry by A. I. Vogel.
2. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K. Ahluwalia, R. Aggarwal.
3. Practical Organic Chemistry: A Student Handbook of Techniques by J. R. Mohrig, D. F. Heathcock, and D. G. Mackean.
4. Organic Chemistry Laboratory Notebook by Hayden-McNeil.
5. Experimental Organic Chemistry: A Miniscale and Microscale Approach by John C. Gilbert and Stephen F. Martin.
6. Advanced Practical Organic Chemistry by Dorothy M. Conlon and Kevin O. Smi.

Mapping of CLOs and PSOs

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



B.Sc. SEMESTER VI

Major Practical Course – XIV

COURSE NAME: Chemistry Practical –XIV

COURSE CODE: CHEMJ-S6PR14-2CR26 [CREDITS -02]

Course Learning Objective

Learning Objective:

- To equip students with the knowledge of performing practicals related to pH metry, conductometry, colourimetry, refractometry, chemical kinetics and surface tension.

Course learning outcome

Learning outcome:

At the end of this course, students will be able to

1. Demonstrate proficiency in performing practicals related to pH metry, conductometry, colourimetry, refractometry, chemical kinetics and surface tension.

PHYSICAL CHEMISTRY PRACTICALS

1. To investigate rate of reaction between KBrO_3 and KI , $a = b$
2. To investigate rate of reaction between KBrO_3 and KI , $a \neq b$
3. To determine the specific rate constant for the alkaline hydrolysis of ethylacetate at room temperature and to find out its order of reaction.
4. Surface Tension: To compare the cleansing power of two detergents by measuring surface tension of their solutions.
5. pH metry: To determine the dissociation constant of Dibasic acid by titration of dibasic acid and strong base.
6. Detection of Vitamin C in a tablet by pH metry.
7. Conductometry: To determine the amount of vanillin in the given vanilla solution.
8. Colourimetry: To determine the indicator constant of Phenolphthalein.
9. Colourimetry: To verify Lambert-Beer's law for KMnO_4 solution.
10. Refractometry: To determine the specific refractivities of the given liquids A, B and their mixtures containing 20%, 40% and 60% and unknown liquid by volume.

List of Major Textbooks:

1. Experimental Physical Chemistry, V. D. Athawale, 2007, New Age International Publishers.
2. Physical Chemistry Experiments, R. Rajalakshmi, 2020, Notion press Publishers.
3. Senior Practical Physical Chemistry, Khosla B. D.; Garg V. C. & Gulati A., R. Chand



& Co.:
New Delhi (2011).

4. Practical Physical Chemistry by J. B. Yadav, 2001 Goel Publishing House.

Mapping of CLOs and PSOs

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



B. Sc. SEMESTER VI

Minor Practical Course - VI

COURSE NAME: Chemistry Practical Minor-VI

COURSE CODE: CHEMN-S6PR6-2CR26 [CREDITS – 02]

Course learning Objective

Learning Objectives:

- 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

Course Learning Outcome

Learning Outcomes:

At the end of this course, students will be able to

1. Illustrate the preparation of standard solutions, common soaps and detergent.
2. Prepare various types of cosmetics in laboratory.

CHEMISTRY LAB OPERATIONS & PREPARATION OF COSMETICS

Chemistry Lab Operations

1. Preparation technique of standard solutions.
2. Laboratory preparation of standard soap.
3. Laboratory preparation of liquid soap.
4. Laboratory preparation of detergent.

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. Practical Organic Chemistry, O.P. Agarwal, Krishna Prakashan Media (P) Ltd.
2. Vogel's Textbook of Practical Organic Chemistry, A.I. Vogel, Pearson Education / Longman Scientific & Technical, 5th Edition (Updated by B.S. Furniss et al.)
3. Comprehensive Practical Organic Chemistry – Preparations and Quantitative Analysis, V.K. Ahluwalia and Renu Aggarwal, University Press (India) Pvt. Ltd.
4. Vogel's Textbook of Quantitative Chemical Analysis, G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney, Pearson Education / Longman Scientific & Technical, 6th Edition

Mapping of CLOs and PSOs

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