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: M. Sc.

Course: Organic Chemistry

For

Academic year

2026-27

(NEP-2020)

(To be effective from June, 2026)

M. Sc. (CHEMISTRY) SEMESTER I

Core Course-1

COURSE NAME: INORGANIC CHEMISTRY-I

COURSE CODE: CHEMSC-S1P1-4CR26 [CREDITS - 04]

Course Learning Outcome		
After the successful completion of the course, the learner will be able to: 1. Explain the of matrices and vectors matrix notations, reducible representation, evaluate their relation, solve problems involving applications of group theory. 2. Define terms related to magnetic properties and differentiate between types of magnetic bodies. 3. Determine magnetic susceptibility and its applications. Solve problems involving applications of magnetic moment. 4. Describe different types of inorganic reaction mechanism, differentiate between acid hydrolysis & base hydrolysis, characterize conjugate base mechanism 5. Solve problems involving their synthetic application. 6. Classify coordination compounds and explain Werner's theory. 7. Explain electronic interpretation, and factors affecting the formation of complex ions. 8. Describe detection of complex ion in solution. 9. Analyze stability of metal chelates and discuss their importance in various fields.		
Module 1	**MOLECULAR SYMMETRY AND GROUP THEORY**	**[15L]**
Learning Objectives: This module is intended to • Acquaint the students with the knowledge of Symmetry operations and Group theory.		
Learning Outcome: After the successful completion of the module, the learner will be able to • Define and characterize the matrices and vectors matrix notations, reducible representation, evaluate their relation, explain matrix operations • Solve problems involving applications of group theory.		
1.1	**Molecular Symmetry and Group Theory:** Recapitulation of point groups, Symmetry criterion of optical activity, symmetry restrictions on dipole moment. A systematic procedure for symmetry classification of molecules, Concepts of Groups, Sub-groups, Classes of Symmetry operations, Group Multiplication Tables. Abelian and non-Abelian point groups, a) Representation of Groups: Matrix representation of symmetry operations, reducible and irreducible representations. The Great Orthogonality Theorem and its application in construction of character tables for point groups C_{2v} and C_{3v}. Structure of character tables.	

	b) Determination of symmetry species for translations and rotations. c) Mulliken's notations for irreducible representations. d) Reduction of reducible representations using reduction formula. Applications of Group Theory Symmetry adapted linear combinations (SALC), symmetry aspects of MO theory, sigma bonding in ABn (NH_3, CH_4) molecule.	
Module 2	**ELEMENTS OF MAGNETOCHEMISTRY**	**[15L]**
Learning Objectives: This module is intended to • Acquire knowledge of magnetic properties and sources of paramagnetism and diamagnetism.		
Learning Outcome: After the successful completion of the module, the learner will be able to • Define terms related to magnetic properties and differentiate between types of magnetic bodies. • Determine magnetic susceptibility and its applications. Solve problems involving applications of magnetic moment.		
1.2	Elements of magneto chemistry: Definitions of magnetic properties, type of magnetic bodies, the source of paramagnetism, diamagnetism and Pascal's constant, Example of Pascals constant. Curie and Curie- Weiss law, Magnetic Properties of transition elements. Determination of magnetic susceptibility: (a) Gouy method (b) Faraday method (c) Null deflection method (d) NMR method (e) Evans method Application of magnetic susceptibility measurements, Temperature independent paramagnetism (TIP), Orbital contribution to magnetic moment.	
Module 3	**INORGANIC REACTION MECHANISM**	**[15L]**
Learning Objectives: This module is intended to • Make students aware about the principles and concepts of inorganic reaction mechanism		
Learning Outcome: After the successful completion of the module, the learner will be able to • Describe different types of inorganic reaction mechanism, differentiate between acid hydrolysis & base hydrolysis, characterize conjugate base mechanism • Solve problems involving their synthetic application		

1.3	Labile and inert complexes, factors responsible for lability and inertness of complexes. Classification of mechanism and energy profile of reaction, interpretation of liability and inertness of transition metal complex on the basis of reaction rate, Valence Bond Theory (VBT) and Crystal Field Theory (CFT), Transition state or activated complex, substrate, attacking reagents-electrophilic and nucleophilic, Kinetic application of CFT. Kinetics of octahedral substitution, mechanism of nucleophilic substitution reactions in octahedral complexes, acid hydrolysis, factor affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, substitution reactions without breaking metal-ligand bond, redox (single electron transfer) reactions	
Module 4	**COORDINATION CHEMISTRY**	**[15L]**

Learning Objectives:

This module is intended to

- Make the students aware about the basic principles of coordination chemistry, Werner's theory, complexes and chelates, their structure and different applications

Learning Outcome:

After the successful completion of the module, the learner will be able to

- Classify coordination compounds and explain Werner's theory
- Explain electronic interpretation, and factors affecting the formation of complex ions
- Describe detection of complex ion in solution
- Analyze stability of metal chelates and discuss importance of chelates
- Explain role of metal chelates in living system

1.4	Classification of coordination compounds, Werner's theory of coordination, Electronic interpretation of coordination compounds, Factors effecting the formation of complex ions, detection of complex ion in solution, determination of composition of complex ions (Job's method and Mole ratio method), Chelation, Factors influencing the stability of metal chelates, Importance of chelates, Role of metal chelates in living system. Inner complexes and polynuclear complexes.	

References:

1. Chemical applications of group theory by F.A Cotton (Second edition), Wiley Eastern Limited, 1976 New Delhi.
2. Group theory and its application by P.K. Bhattacharya, Himalaya publishing hours, Mumbai, 1986.
3. Selected topics in Inorganic Chemistry, malik, Tuli and madan S. Chand and Company.

4. Inorganic Chemistry 3rd ed. D. F. Shriver and P. W. Atkins, Oxford University Press, 1999, Chapter 16.
5. Group theory and symmetry by L. R. Hall, McGraw hill, New York, 1989.
6. Kinetic and Mechanism by A. A. Frost and R. G. Pearson, Wiley, New York, 1961.
7. Mechanism of Inorganic Reactions by F. Basolo and R.G. Pearson, Second Edition, Wiley Eastern Limited, New Delhi, 1977.
8. Advanced Inorganic Chemistry by F.A. Cotton and R.G. Wilkinson, John Wiley & Sons, N. Y.
9. Principles of Inorganic Chemistry, by Puri. Sharma and Kalia, 33rd Edition, Vishal publishing Co. Jalandhar, Delhi, 2017.
10. Advanced Inorganic Chemistry by S. K. Agarwala and Keemtilal, Pragati Prakashan, Meerut.
11. Inorganic Chemistry by Gary L Miessler and Donald A. Tarr, Pearson Education International.
12. Coordination chemistry by Gurdeep chatwal and M.S. Yadav, Himalaya publishing hours, Mumbai, 1986.
13. Symmetry and spectroscopy of molecules by K.Veera Reddy. New Age international publishers

e-Resources:

Module 1:

1. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_pg/668
2. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/applications_of_molecular_symmetry_and_group_theory/06.classification_of_molecules_into_point_group._part-1/et/4845_et_et.pdf
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/applications_of_molecular_symmetry_and_group_theory/35.symmetry_and_chemical_bonding_part-4_mo_formation/et/4874_et_et.pdf
4. Swayam Prabha: http://www.youtube.com/embed/tcWjJdBGV9c

Module 2:

1. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_pg/658
2. https://archive.org/details/magnetochemistry032763mbp

Module 3:

1. https://egyankosh.ac.in/bitstream/123456789/108322/1/Unit-1.pdf
2. https://archive.org/details/inorganicreactio0000unse_a2b8/page/n5/mode/2up
3. https://archive.org/details/inorganicreactio0000tobe_e0k4
4. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000658/M019075/ET/1515586718CHE_P3_M25_etext.pdf

Module 4:

1. https://www.swayamprabha.gov.in/program/archive_he/22
2. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/96
3. https://courses.lumenlearning.com/suny-binghamton-chemistry/chapter/coordination-chemistry-of-transition-metals-2/

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes										
	1	2	3	4	5	6	7	8	9	10	11
1	√		√				√				
2.	√		√								
3.	√		√				√				
4.	√		√								
5.	√		√				√				
6.	√		√								
7.	√										
8.	√										
9.	√		√						√		

M. Sc. (CHEMISTRY) SEMESTER I

Core Course-2

COURSE NAME: ORGANIC CHEMISTRY-I

COURSE CODE: CHEMSC-S1P2-4CR26 [CREDITS - 04]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Discuss the generation of reactive intermediates, their mechanism, rearrangement based on each intermediate and apply the concept in organic synthesis and industrial application. 2. Define basic principles and classify different types of pericyclic reaction and construct Woodward-Hoffman correlation diagram and derive the selection rule for electrocyclic, cycloaddition and sigmatropic reaction. 3. Apply the acquired knowledge to solve complex problems related to pericyclic reactions in the context of organic chemistry. 4. Describe the mechanisms of aliphatic nucleophilic substitution reactions (SN_2, SN_1, SN_i). 5. Identify and interpret reactions involving allylic halides neighboring group participation, and reaction rate enhancement. 6. Evaluate the factors affecting reactivity in aromatic nucleophilic substitution reactions. 7. Apply, predict regioselectivity in elimination reactions and design synthesis on the basis of Hoffmann and Zaitsev's rules. 8. Define and explain fundamental principles including stereoisomerism, stereo selective and stereo specific reactions, resolution techniques, basics of conformational analysis, interconversions and newer method of asymmetric synthesis.

Module 1	REACTION MECHANISM & REACTIVE INTERMEDIATES	[15L]

Learning Objectives:

This module is intended to

- Make students familiarize with fundamental concepts of reactive intermediates, their mechanism, rearrangement and their application in organic synthesis and industries.

Learning Outcome:

After the successful completion of the module, the learner will be able to

- Discuss the generation of reactive intermediates, their mechanism, rearrangement based on each intermediate.
- Apply the concept of reactive intermediate in organic synthesis and industrial application.

1.1	Detailed study of organic reaction intermediates. Generation, structure, stability, reactions and factor affecting of reactivity; **Carbocations (Classical and non-classical):** Phenonium ion, norbornyl system, common carbocation rearrangements, Demjanov, Dienone-Phenol, Rupe. **Carbanions:** Mechanism of condensation involving enolates - Aldol, Mannich, Dieckmann, Michael and Shapiro reactions. **Carbenes:** Mechanism of Arndt-Eistert reaction, Wolf rearrangement and Bamford Steven's rearrangement reaction. **Free Radicals:** Coupling of alkenes and arylation of aromatic compounds by diazonium salts, Sandmeyer Reactions, Free radical rearrangements-Hunsdiecker Reaction.	
Module 2	**PERICYCLIC REACTION**	**[15L]**
Learning Objectives: This module is intended to • Familiarize students understand, remember and apply the fundamental principles and theories of pericyclic reactions		
Learning Outcome: After the successful completion of the module, the learner will be able to • Define basic principles and classify different types of pericyclic reaction • Construct Woodward-Hoffman correlation diagram and derive the selection rule for electrocyclic, cycloaddition and sigmatropic reaction • Apply the acquired knowledge to solve complex problems related to pericyclic reactions in the context of organic chemistry		
2.1	**Introduction** - Definition, Characteristics and Classification of Pericyclic reaction, Molecular orbitals and symmetry properties of ethylene, 1,3-butadiene, 1,3,5- hexatriene and allyl systems. **Electrocyclization Reactions and reversion of cyclization reaction:** Woodward-Hoffman Correlation diagram and derivation of selection rules, Conrotatory and disrotatory motions, FMO, PMO & orbital symmetry approach for 4n and (4n+2) electron system and allyl systems. **Cycloaddition Reactions**: Antarafacial and suprafacial additions. FMO, PMO & orbital symmetry approach for 4n and (4n+2) electron Systems, Diels- Alder reaction, 1, 3- dipolar cycloadditions, 2+2 addition of ketene. **Sigmatropic rearrangements & Pericyclic reaction of conjugated carbocation & Carbanion:** Suprafacial and antarafacial shifts. The Cope, Oxy-cope reaction, Claisen rearrangements, Ene reaction Examples of electrocyclic, cycloaddition and sigmatropic rearrangements e.g. Oxy-Cope rearrangement etc.	

Module 3	SUBSTITUTION AND ELIMINATION REACTIONS	[15L]
Learning Objectives: This module is intended to • This module is intended to gain comprehensive understanding of advanced organic chemistry concepts including aliphatic and aromatic nucleophilic substitution mechanisms, factors influencing reactivity, and elimination reactions		
Learning Outcome: After the successful completion of the module, the learner will be able to • Describe the mechanisms of aliphatic nucleophilic substitution reactions (SN_2, SN_1, SN_i) • Identify reactions involving allylic halides neighboring group participation, and reaction rate enhancement • Interpret the reactivity patterns of allylic halides and neighboring group participation • Evaluate the factors affecting reactivity in aromatic nucleophilic substitution reactions • Apply and design synthesis Hoffmann and Zaitsev's rules to predict regioselectivity in elimination reactions		
3.1	**A:** Aliphatic Nucleophilic Substitution: The SN_2, SN_1, SN_i mechanisms (Retention and inversion of configuration). Reactions of Allylic halides, neighboring group participation by -OH, -NH_2, - COO-, -RS, C=C, Cyclopropone ring, - halogen, aromatic ring. **B:** Aromatic Nucleophilic Substitution: The SN_2, SN_1 (addition elimination and elimination addition) and benzyne mechanisms, Reactivity - effect of substrate structure, leaving group and attaching nucleophile, The Von Richter rearrangement. **C:** Elimination reaction: Hoffmann and Zaitsev's rule of elimination, E1, E2 and E1CB Reaction and their regioselectivity.	
Module 4	**STEREOCHEMISTRY AND CONFORMATIONAL ANALYSIS**	**[15L]**
Learning Objectives: This module is intended to • Master fundamental principles in organic chemistry, including stereoisomerism, chirality, stereo-selective, and stereo-specific reactions, as well as optical activities in absence chiral center • Comprehend the basics of conformational analysis, interconversions, various projections, and newer methods of asymmetric synthesis		

Learning Outcome:

After the successful completion of the module, the learner will be able to

- Define and explain fundamental principles, stereoisomers, chirality, stereo selective and stereo specific reactions, optical activities, separation of racemic mixture, symmetry elements to check chirality in molecules
- Explain basics of conformational analysis, interconversions, different projections, newer method of asymmetric synthesis, effects of conformation on reactivity and stability

4.1	**A. STEREOCHEMISTRY:** Stereo chemical principles, enantiomeric relationships, distereomeric relationship, R-S and E-Z nomenclature, dynamic stereochemistry, chiral-prochiral relationships, due to faces and ligands, Stereo selective and stereo specific reactions, enantio and diastereo selective excess, racemates and racemic modification, Resolution of racemic modification, optical activity in the absence of chiral carbons biphenyl, allenes, spiranes. **B. CONFIRMATIONAL ANALYSIS:** Interconversion of Fischer, Newman and Sawhorse projections. Newer method of asymmetric synthesis (including enzymatic and catalytic nexus), Bayer's strain theory, chemistry of cyclohexane, (chair & boat cyclohexanes), conformation of mono and disubstituted cyclohexanes (1,1, 1,2 and 1,4), conformation of decalin and perhydrophenanthrene.	

References:

1. Carbenes, Benzynes and Nitrenes by Gilchrist, T. L. and Rees.
2. Mechanism and Theory In Organic Chemistry-2007 by Thomas H. Lowry, Kathleen S. Richardson, Forbes. Harper& Row, Publishers. New York, Hagerstown, San Francisco, London.
3. Advanced Organic Chemistry-Reactions, Mechanism and Strucuture, Jerry March, John Wiley.
4. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
5. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. & Kogekusha Co. Ltd., 1970).
6. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
7. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
9. Organic chemistry 2nd ed. Jonathan Clayden, Nick Greeves, Stuart Warren.
10. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).
11. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
12. Photochemistry and Pericyclic Reactions 3rd ed. by Jagdamba Singh 2010. New Age

International Publishers Ltd. New Delhi.
13. Pericyclic Reactions A mechanistic and problem solving approach Sunil Kumar, Vinod Kumar, S. P. Singh Academic Press 2015.
14. Organic Chemistry - Reaction mechanism, by P.S. Kalsi, New Age International Publishers.

e-Resources

1. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000660/M010066/ET/s000005ch-p000660-m010066-et-v1.pdf
2. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/organic_chemistryii/06.generation,_structure,_stability_and_reactivity_of_carbocations/et/4786_et_et.pdf
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/organic_chemistryii/07.generation%2C_structure%2C_stability_and_reactivity_of_carbanions/et/4787_et_et.pdf
4. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/organic_chemistryii/08.generation,_structure,_stability_and_reactivity_of_free_radicals/et/4788_et_et.pdf
5. https://archive.nptel.ac.in/content/storage2/courses/104103022/download/module8.pdf
6. https://nptel.ac.in/courses/104105104
7. https://youtu.be/OkmQDKBdSzQ?si=79jk8o3VZYeiS8A-
8. https://enine.digimat.in/nptel/courses/video/104106131/L13.html
9. https://youtu.be/F9SXMW16Stw?si=4_W89gfdZciHWIQ7
10. https://archive.nptel.ac.in/courses/104/103/104103110/
11. https://archive.nptel.ac.in/content/storage2/courses/104103022/download/module8.pdf
12. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_pg/660
13. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_pg/664
14. https://youtube.com/playlist?list=PLA1A08D1AF30B1FA3&si=pPrOrVb0nkmIFYjF
15. https://ggsestc.digimat.in/nptel/courses/video/104106077/L29.html
16. https://archive.nptel.ac.in/courses/104/106/104106119/
17. https://enine.digimat.in/nptel/courses/video/104106131/L13.html
18. https://onlinecourses.nptel.ac.in/noc19_cy25/preview
19. https://avcce.digimat.in/nptel/courses/video/104105086/L01.html
20. http://digimat.in/nptel/courses/video/104105086/L21.html

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes										
	1	2	3	4	5	6	7	8	9	10	11
1.	√	√					√				
2.	√	√	√				√				
3.	√	√	√				√				
4.	√	√	√								
5.			√				√				
6.		√	√				√				
7.		√	√				√		√		
8.	√	√	√				√				

M. Sc. (CHEMISTRY) SEMESTER I

Core Course-3

COURSE NAME: PHYSICAL CHEMISTRY-I

COURSE CODE: CHEMSC-S1P3-4CR26 [CREDITS - 04]

Course Learning Outcome
After the successful completion of the Course, the learner will be able to: 1. Describe, recognize and calculate rate of change associated with chemical change, reversible reaction and consecutive reaction. 2. Determine rate law for enzyme catalysis, chain reaction, based on experimental data. 3. Evaluate and solve numerical problems involving different chemical changes. 4. Explain behavior of mixtures and discuss difference between state and path function, partial molar quantities 5. Justify excess functions for non-ideal solutions by deriving expressions for excess thermodynamic functions and solve problems related to PMV, TMV etc. 6. Explain the connection between quantum mechanics and thermodynamics. 7. Describe and derive different parameters of statistical thermodynamics. 8. Identify classification, stereochemistry, kinetic behavior and thermodynamics of polymerization and distinguish different phase techniques and their utility. 9. Explain the difference, formula and techniques to calculate Mn and Mw and their relation to PDI and solve numerical problems. 10. Explain thermal transitions in polymers and its significance.

Module 1	CHEMICAL KINETICS	[15L]

Learning Objectives:

This module is intended to make students

- Understand rate of reversible reaction, Consecutive reactions
- Understand enzyme catalysis, chain reaction
- Understand methods to solve numerical problems involving decomposition reactions

Learning Outcome:

After the successful completion of the module, the learner will be able to

- Describe the concept of rate of change associated with chemical change
- Recognize the rate-change and calculate rate of reversible reaction and consecutive reaction
- Determine rate law for enzyme catalysis, chain reaction, based on experimental data
- Evaluate some decomposition reactions
- Solve numerical problems involving these chemical changes

1.1	Theories of Uni-molecular gas reactions: Lindemann theory, Kinetics of some complex reactions (i) Reversible reactions (only first order opposed by first order) (ii) Consecutive reactions (A→B→C); Equation of Relaxation time for (i) first order opposed by first order and (ii) second order opposed by second order, Steady state treatment or approximation, The Rice–Ramsperger–Kassel (RRK) theory and Rice–Ramsperger–Kassel–Marcus (RRKM) theory of chemical reactivity, enzyme catalyzed reactions, kinetics of general chain reaction, Kinetics of photochemical reactions (H_2-Cl_2 and H_2-Br_2), kinetics, mechanism, determination of activation energy and chain length of some organic decomposition (i) decomposition of ethane (ii) decomposition of acetaldehyde, Effect of Ionic strength on rates of ionic reactions (Primary and secondary salt effect), Numerical.	

Module 2	**THERMODYNAMICS**	**[15L]**

Learning Objectives:

This module is intended to

- Impart knowledge about behavior of mixtures
- Understand State and Path functions and difference between them
- Understand Partial molar quantities
- Explain the behavior of mixtures specially in explaining Thermodynamic parameters
- Justify excess functions for non-ideal solutions by deriving expressions for excess thermodynamic functions
- Solve numericals

Learning Outcome:

After the successful completion of the module, the learner will be able to

- Explain behavior of mixtures
- Discuss difference between state and path function, partial molar quantities
- Justify excess functions for non-ideal solutions by deriving expressions for excess thermodynamic functions
- Solve problems related to PMV, TMV etc.

2.1	Introduction to Laws of thermodynamics, state and path functions and their applications, thermodynamic description of various types of processes, Maxwell's relations, partial molar quantities, calculation of partial molar quantities, determination of partial molar volume and partial molar enthalpy, ideal and non- ideal liquid mixtures, Thermodynamics functions of mixing of non- ideal solutions (i) free energy of mixing (ii) entropy of mixing (iii) volume of mixing and (iv) enthalpy of mixing, Excess functions (μ^E, G^E, S^E, H^E and V^E) for non-ideal solutions and expression for excess thermodynamic functions, introduction to non-equilibrium thermodynamics, numericals.	

Module 3	STATISTICAL THERMODYNAMICS	[15L]

Learning Objectives:

This module is intended to

- Understand types of assembly, types of ensembles and different thermodynamic terms
- Understand, concept of three different statistics and partition functions
- Derive the relation between thermodynamic parameters such as pressure, temperature
- Entropy and heat capacity from the distribution functions

Learning Outcome:

After the successful completion of the module, the learner will be able to

- Explain the connection between quantum mechanics and thermodynamics
- Describe and derive thermodynamic statistic and differentiate them
- Derive the vibrational and translational partition functions
- Derive and compute thermodynamic functions from partition functions
- Describe the different ensembles

3.1	Basics of Statistical thermodynamics (Assembly, Canonical ensemble, occupation number statistical weight factor, probability), Thermodynamic probability, Probability and entropy, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Lagrange's methods of multipliers, Partition function, Thermodynamic properties in term of partition functions (i) Internal energy (ii) Heat Capacity (iii) Helmholtz free energy (iv) Enthalpy (v) Gibb's free energy (vi) Chemical potential (viii) Equilibrium constant Molecular partition functions for an ideal gas, Derivation for Translational, Rotational and Vibrational partition functions Numerical.	

Module 4	POLYMER CHEMISTRY	[15L]

Learning Objectives:

This module is intended to understand

- Various ways of classification of polymers and their stereochemistry
- Kinetics of addition and condensation polymerization, thermodynamics, phase techniques and Mn, Mw, Mz, Mv and PDI of polymerization
- Techniques to determine molecular weight of polymers like viscometry & osmometry
- Thermal transitions in polymers & its significance and solving numericals

Learning Outcome:

After the successful completion of the module, the learner will be able to

- Identify classification, stereochemistry, kinetic behavior and thermodynamics of polymerization.
- Distinguish different phase techniques and their utility.
- Explain the difference and formula to calculate Mn and Mw and their relation to PDI and solve numerical problems.
- Explain various techniques to determine average molecular weights and solve numerical problems related to them.
- Explain thermal transitions in polymers and its significance

4.1	Types of polymers, Stereochemistry of polymers, Kinetics of Addition polymerization (free radical, cationic and anionic) and Condensation polymerization, Thermodynamics of polymerization, Phase techniques of polymerization (Bulk, solution, suspension and emulsion), Number & Mass average Molecular mass (Mn, Mw, Mz, Mv determination), Polydispersity Index (P.D.I) Molecular mass determination by Viscometry and Osmometry, Mark–Houwink equation for determining intrinsic viscosity, Thermal transitions in polymer: glass transition temperature and its significance, numericals.	

References:

Module I:

1. Essential of chemical kinetics by Dr. Harishchandra A. Parbat and Dr. Damodar V., Prabhu, Sara Publication, 1st edition, (2022).
2. Chemical Kinetics, Laidler K.J. Tata Mcgraw-Hill Publishing Co. Ltd.
3. Principles of Chemical Kinetics, James E. House, Elsevier Publication.
4. Kinetics and Mechanism of Chemical Transformations, Rajaraman, J. and Kuriacose, J., McMillan (2008).
5. Kinetics of chemical reactions, S.K. Jain, Vishal Publications.
6. Engel, T. & Reid, P. Physical Chemistry, Pearson.
7. Maron, S. & Prutton Physical Chemistry.

Module II:

1. Thermodynamics for chemist Samuel Glasstone, East-West Press Pvt. Ltd. (2008).
2. Physical Chemistry, Volume1: Thermodynamics and Kinetics (10th Ed) by Professor Peter Atkins, Julio De Paula.
3. Principles of Physical Chemistry Puri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co.
4. A textbook of Physical Chemistry by K.L. Kapoor, Vol-5, McMillan India Ltd. 2007.
5. An introduction to chemical thermodynamics, R.P. Rastogi and R.R. Mishra, Vikas Publishing house Pvt. Ltd. 6th edition.
6. Advanced Physical Chemistry, D.N. Bajpai, S.Chand & Company Ltd. 2nd edition.

Module III:

1. Statistical thermodynamics, M.C. Gupta, New Age International, 2007.
2. An introduction to statistical thermodynamics, Terrell L. Hill, Addition Weslay Publishing Co.
3. Principles of Physical Chemistry, B. R. Puri, L.R. Sharma, M.S. Parthania, Vishal Publishing Co.

4. A text book of Physical Chemistry, K. L. Kapoor, Vol-5, Macillan India Ltd. 2007.

Module IV:

1. Polymer science by V. R. Gowarikar. Wiley Eastern Ltd.
2. Principal of polymer chemistry by A. Ravve, Springer.
3. A Textbook of Polymer Chemistry, M S Bhatnagar, S Chand Publications.
4. Principles of Physical Chemistry Puri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co.

e-Resources:

Module I:

1. https://archive.nptel.ac.in/courses/104/101/104101128/
2. https://www.swayamprabha.gov.in/program/archive_he/22 Chemical Kinetics 1-16
3. https://www.swayamprabha.gov.in/program/archive_he/37 Chemical kinetics and transition state theory
4. https://courses.lumenlearning.com/chemistryformajors/chapter/introduction-to-kinetics/

Module II:

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
2. https://college.dhsk.org/uploads/school_content/material/18.pdf
3. https://ocw.mit.edu/courses/5-60-thermodynamics-kinetics-spring-2008/video_galleries/video-lectures/
4. https://www.uou.ac.in/sites/default/files/slm/MSCCH-503.pdf
5. https://nptel.ac.in/courses/104101139
6. https://www.youtube.com/watch?v=txHJDSqZK70
7. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000661/M019096/ET/1515647578CHE_P6_M1_etext.pdf

Module III:

1. https://college.dhsk.org/uploads/school_content/material/18.pdf
2. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000661/M019098/ET/1515647709CHE_P6_M5_etext.pdf
3. https://www.coursera.org/learn/statistical-thermodynamics?action=enroll (Coursera mooc course)
4. https://www.coursera.org/specializations/statistical-thermodynamics-engineering (Coursera mooc course)

Module IV:

1. https://uou.ac.in/sites/default/files/slm/MSCCH-508.pdf
2. https://archive.nptel.ac.in/courses/104/105/104105039/
3. https://archive.nptel.ac.in/courses/104/105/104105124/
4. Swayam Prabha: https://www.swayamprabha.gov.in/index.php/program/archive_he/17

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes										
	1	2	3	4	5	6	7	8	9	10	11
1.	√	√	√								
2.		√	√				√				
3.		√	√				√				
4.	√	√									
5.	√	√	√				√				
6.	√										
7.	√										
8.		√	√				√				
9.	√	√	√								
10.	√										

M. Sc. (CHEMISTRY) SEMESTER I

Skill Enhancement Course-I

COURSE NAME: ORGANIC SPECTROSCOPY AND CHROMATOGRAPHY

COURSE CODE: CHEMSC-S1SEC1-2CR26 [CREDITS - 02]

Course Learning Outcome		
After the successful completion of the Course, the learner will be able to: 1. Define the basic concept of UV-Visible and IR spectroscopic methods and their applications. 2. Describe principle, basic concepts, and terms, stationary and mobile phases of TLC, HPTLC and HPLC. 3. Apply and illustrate the knowledge of organic spectroscopy and liquid chromatography in research and industry.		
Module 1	**ORGANIC SPECTROSCOPY: UV AND IR SPECTROSCOPY**	**[15L]**
Learning Objectives: This module is intended to • Understand principles and concepts of UV and IR spectroscopic methods		
Learning Outcome: After the successful completion of the module, the learner will be able to • Define the basic concept of electronic transitions and effects on wavelength absorption • Calculate the λ_{max} of different organic molecules • Apply fundamental concepts of UV-Visible and IR spectroscopic methods		
1.1	(A) [Recapitulation: Introduction of Electromagnetic Radiation] Types of electronic transition, chromophore, auxochrome, hypsochromic effect, bathochromic effect, hyperchromic effect, hypochromic effect, Factor affecting λ_{max} like resonance, hyper conjugation, hydrogen bonding, steric effect, Woodward's rules for calculation of λ_{max} for diene-enones systems, aromatic substituents, effect of solvent on absorption bands. (B) IR spectroscopy: introduction: theory, useful terms: IR region, types of vibrations: fundamental and overtones, linear and non-linear molecule, selection rule, factors influencing vibrational frequencies: coupling, fermi resonance, hydrogen bonding, electronic effects, IR spectra: group frequency regions, fingerprint region, instrumentation-IR and FTIR	
Module 2	**CHROMATOGRAPHY**	**[15L]**
Learning Objectives: This module is intended to • understand the key steps in performing Thin layer chromatography (TLC) and HPTLC		

- understand the terms and factors involved in TLC and HPTLC
- understand the steps involved in a chromatographic investigation
- understand liquid chromatography with special focus on the instrumentation of high-pressure liquid chromatography in detail and their application in various field

Learning Outcome:

After the successful completion of the module, the learner will be able to

- Describe the expression for the partition coefficient, principle of TLC and HPTLC
- Explain the difference between mobile phase and stationary phases
- Recognize the use of different stationary and mobile phase for the separation of organic molecule in liquid chromatography
- Explain the working of different components of HPLC
- Identify the problems and their solution during the analysis

2.1	Thin-Layer Chromatography: Selection of stationary and mobile phase, Detection techniques – Elementary idea of HPTLC Liquid chromatography: Principle, Comparison with GC, Principle of HPLC, Instrument and significance of each component, Pumps, Guard column, Method of introducing sample, Criteria in selection of mobile phase, Stationary phases (solid, liquid), Bonded phase supports, Column used in HPLC Normal phase and Reversed phase, Isocretic and Gradient Elution Detectors: UV absorption, RI detectors	

References:

1. Fundamental of molecular spectroscopy, C. N. Banwell, Tata Mc-Graw Hill Pub. Camp.
2. Spectrometric Identification of Organic Compounds (4th edition/5th edition), Silverstein, Bassler & Morril, John Wiley & Sons.
3. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw – Hill.
4. Modern Spectroscopy, J. M. Hollas, John Wiley.
5. Basic Principles of Spectroscopy, R. Chang, McGraw-Hill.
6. Modern Methods of Chemical Analysis (2nd ed.), Pecsok, Shields, Cairns & McWilliam, John Wiley& Sons.
7. Instrumental Analysis by R. D. Braun, McGraw-Hill.
8. Introduction to Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
9. Fundamentals of Analytical Chemistry: Skoog D. R. and West D. M. (Holt, Rinehart & Winston,New York).
10. Instrumental Methods of Analysis by G. W. Ewing.
11. Modern Method of Chemical Analysis by Pecsok, Shield, Cairns, McWilliam, John Wiley and Sons.
12. Quantitative Analysis, 6th Ed., R. A. Day and A. L. Underwood, Prentice – Hall of India,1993.
13. Instrumental Analysis: G. D. Caristian and J. E. O'Reilly (Allyn & Bacon Inc., New York, 2nd edition.

14. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, New York), 5th edition.
15. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (Van Nostrand Reinhold Co., New York), 6th edition.
16. Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2nd edition.
17. Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), NewDelhi.
18. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall Internationaledition).
19. Introduction to Modern Liquid Chromatography: L. R. Snyder & J. J. Kirkland (John Wiley & Sons,New York).
20. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York

e-Resources:

(Module-1)

1. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/12.organic_spectroscopy/01.uv-visible_spectroscopy_and_instrumentation_technique/et/5556_et_et.pdf
2. 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
3. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Vibrational_Spectroscopy/Infrared_Spectroscopy

(Module-2)

1. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000944AC/P000972/M027159/ET/1517982535Module-2QuadrantIe-Text.pdf
2. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumentation_and_Analysis/Chromatography/Liquid_Chromatography
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P001352/M026967/ET/1516861979FSC_P4_M26_e-text.pdf

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1.	√		√								
2.	√		√								
3.	√	√	√			√	√				

M. Sc. (CHEMISTRY) SEMESTER I

Indian Knowledge System-I

COURSE NAME: ANCIENT INDIAN CHEMICAL SCIENCE AND RASASHASTRA

COURSE CODE: CHEMSC-S1IKS1-2CR26 [CREDITS - 02]

Course Learning Outcome
After the successful completion of the course, the learner will be able to 1. Define Rasashastra, recall and describe its historical development and basic concepts in ancient Indian chemical science. 2. Identify, list and classify traditional chemical substances such as Lavana, Kshara, Amla, and related Rasashastra terminology. 3. Explain the basic preparative techniques and chemical processes used in Rasashastra such as Kajjali preparation, Bhavana, calcination, distillation, and sublimation. 4. Describe ancient chemical laboratory practices, instruments, and apparatus used in Rasashastra for heating, grinding, distillation, and weighing. 5. Identify and explain the basic concepts of atomic theory in Vaisheshika philosophy, including Paramanu, Dvyanuka, and Tryanuka, and list the traditional processes involved in Bhasma preparation in Rasashastra. 6. Interpret the preparation and testing of Bhasma and explain its relation to nanochemistry and modern analytical techniques such as SEM, XRD, and TEM.

Module 1	**FOUNDATIONS OF RASASHASTRA AND ANCIENT CHEMICAL TECHNOLOGY**	**[15L]**

Learning Objectives:

This module is intended to

- Introduce the historical and philosophical foundations of Rasashastra
- Familiarize students with the terminology and classification of chemical substances in Rasashastra
- Undesrstand ancient laboratory practices, instruments, and metallurgical techniques used in Rasashastra
- Understand traditional chemical processes such as purification, trituration, calcination, and distillation

Learning Outcome:

After the successful completion of the module, the learner will be able to

1. Define Rasashastra, recall and discribe its historical development and basic concepts in ancient Indian chemical science.

2. Identify, list and classify traditional chemical substances such as Lavana, Kshara, Amla, and related Rasashastra terminology.
3. Explain the basic preparative techniques and chemical processes used in Rasashastra such as Kajjali preparation, Bhavana, calcination, distillation, and sublimation.
4. Describe ancient chemical laboratory practices, instruments, and apparatus used in Rasashastra for heating, grinding, distillation, and weighing.

1.1	**Introduction to Rasashastra:** • History and development of Rasashastra • Etymology of Rasa and concept of Rasayana • Rasashala (ancient chemical laboratory) **Terminology Used in Rasashastra:** • Traditional classification of chemical substances such as salts, alkalis, acids, and organic materials. (e.g. Lavana-panchaka and Lavana-shataka, Kshara-panchaka, Kshara-dvaya, Kshara-traya, Ksharashtaka etc.) **Important Rasashastra Preparative Terms:** • Concepts related to trituration, purification, alloy formation, and metallurgical processing. (e.g. Kajjali, Rasapanka, Rasapishti (Navanita pishti, Patana pishti), Bhavana, Dhalana etc.). **Ancient chemical processes**: calcination, distillation, sublimation • Metallurgical knowledge in Rasashastra • Instruments and apparatus in Rasashastra used for heating, grinding, distillation and weighing	
Module 2	**FOUNDATION OF ATOMIC THEORY AND NANOCHEMISTRY IN ANCIENT INDIA**	**[15L]**

Learning Objectives:

This module is intended to

- Introduce the atomic theory proposed in Vaisheshika philosophy
- understand the philosophical concept of matter and atomic combinations in ancient Indian science
- Correlate Rasashastra processes with nanochemistry and material science
- Understand traditional Bhasma preparation and its validation through modern analytical techniques

Learning Outcome:

After the successful completion of the module, the learner will be able to

1. Identify and explain the basic concepts of atomic theory in Vaisheshika philosophy, including Paramanu, Dvyanuka, and Tryanuka, and list the traditional processes involved in Bhasma preparation in Rasashastra.
2. Interpret the preparation and testing of Bhasma and explain its relation to nanochemistry and modern analytical techniques such as SEM, XRD, and TEM.

2.1	• Atomic theory in Vaisheshika philosophy • Concept of 'Padartha' (Matter) • Formation of atoms: Paramānu (Atom), Dvyanuka (Diatomic), and Tryanuka (Triatomic) • Chemical transformations: Pīlu-pāka (Atomic heating) and Pithara-pāka (Molecular heating) • Converting minerals and metals into medicine, Bhasma :Reducing particle size to nano-scale • Puta Vigyan (Ancient Pyrometry): Controlling temperature for nanoparticle synthesis • Marana (Incineration): Conversion of metals into Bhasma (Oxidation process). • Bhasma Testing: 'Varitara' (Buoyancy test) and 'Rekhapurnatva' (Fineness test). • Parada (Mercury): Properties of Mercury as a natural catalyst. • Kajjali Preparation: Basics of Colloidal Chemistry in ancient India. • Modern Analysis: Validating Bhasmas using SEM, XRD, and TEM techniques.	

Reference Books:

1. A History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D. by Prof. P. C. Ray, (1902) published by The Bengal Chemical and Pharmaceutical Works.
2. History of Science and Technology in Ancient India: Volume II – Metal Technology by Debiprasad Chattopadhyaya (1986) published by Firma KLM, Calcutta.
3. Introduction to Indian knowledge system concepts and Applications by B. Mahadevan, Vinayak Rajat Bhatt, Nagendra Pavana R. N.
4. "The Ayurvedic Pharmacopoeia of India" - Govt. of India.
5. "Charaka Samhita"- Maharshi Charaka.
6. Ray, P. (1956) History of Chemistry in Ancient and Medieval India, incorporating the

History of Hindu Chemistry by Acharya Prafulla Chandra Ray. Calcutta: Indian Chemical Society.
7. Chandogya Upanisad (S. Lokeswarananda, Trans.). (1995). Sri Ramakrishna Math.
8. Chattopadhyaya, D. (1982). Studies in the history of science in India (Vol. 1). Editorial Enterprises.
9. Bhagwat, V. S. R., Kurkute, B. R., Shinde, B. T., & Tapare, S. K. (2017). Classification of Rasadravyas In Rasashastra. World Journal of Pharmaceutical Research, 6(4), 792–802. https://doi.org/10.20959/wjpr20174-8226.
10. G. T., C., Geethesh, R. R., & Angadi, R. (2018). Collocation Of Rasa Dravyas – An Exploration. International Ayurvedic Medical Journal, 6(9), 2102–2108. http://www.iamj.in/posts/images/upload/2102_2108.pdf.
11. Danino. Michel, Technology in Ancient India.
12. Jena, D. (2021). Concept of chemical science in Vedic literature. International Journal of Trend in Scientific Research and Development, 5(4), 43. https://www.ijtsrd.com/papers/ijtsrd41144.pdf.
13. Joshi, Damodar. (1997) History of Technology in India, Vol. 1, From Antiquity to c. 1200 A.D. by A. K. Bag. New Delhi: Indian National Science Academy. (Chapter Mercurial and Metallic Compunds: Page 256).
14. Charaka Samhita. Ayurveda Dipika Commentary by Chakrapanidutta. Varanasi: Chaukhambha Surbharati Prakashan (2000). (Chikitsa Sthana 7/111 pp 456).
15. Chandrashekhar. J., et. al., Therapeutic Potentials of Minerals in Ancient India : A Review through Charaka Samhita. J Res Edu Indian Med, Jan - Mar 2014; Vol. XX (1): 9-20.
16. Maurya, S. K., Seth, A., Laloo, D., Singh, N. K., Singh Gautam, D. N., & Singh, A. K. (2015). Śodhana: An Ayurvedic process for detoxification and modification of therapeutic activities of poisonous medicinal plants. Ancient Science of Life, 34(4), 188.
17. Council of Scientific and Industrial Research publications on Bhasma characterization using SEM, XRD and TEM.
18. Pal, D. et al. “Physicochemical characterization of Ayurvedic Bhasma.” Journal of Ayurveda and Integrative Medicine.
19. Rai, A., et al.
20. “Nanomedicine in Ayurveda: Bhasma as natural nanoparticles.” International Journal of Ayurveda Research.
21. Rasaratna Samuccaya – Ambikadatta Shastri (Ed.).

e-Resources:

1. Rasa Ratna Samucchaya Of Vagbhatacharya Shankar Lal Hari Shankar : Shankar Lal Hari Shankar : Free Download, Borrow, and Streaming : Internet Archive https://share.google/pxkeeTMmJuPq5xxsx
2. ebharati-pdf-1647235789RasaRatnakara-SiddhaNityaNath-Tika-Shaka-1831_compressed.pdf https://share.google/UgTIlwH2jNh3bgyM0
3. Vaisesika Sutra Of Kanada : Debasish Chakrabarty : Free Download, Borrow, and Streaming : Internet Archive https://share.google/P7LFsIORVVIzqS67w

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1.	√	√					√				√
2.	√	√					√				
3.	√	√	√	√		√	√				
4.	√	√		√		√	√				
5.	√	√	√			√	√				
6.	√	√	√	√	√	√	√	√			

M. Sc. (CHEMISTRY) SEMESTER I

Practical Core Course-1

COURSE NAME: PRACTICAL INORGANIC CHEMISTRY-I

COURSE CODE: CHEMSC-S1PR1-2CR26 [CREDITS - 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Illustrate basics analysis and separation of Inorganic mixtures.
2. Identify anions by dry test of the mixture.
3. Identify each cation and confirm it by confirmative test.
4. Demonstrate different methods of Preparations of inorganic salts.
5. Appreciate good laboratory practices.

Learning Objectives

This module is intended to

- Impart basic knowledge of qualitative analysis of Inorganic mixture
- Identify three anions and three cations including one rare earth element by group separation
- Impart knowledge of different radicals by confirmative test
- Learn preparation of inorganic metal salts and it's crystallization

Contents

1. Inorganic Qualitative Analysis:

(Six elements including ONE rare element)

2. Inorganic Preparation.

a. Hexa-ammine nickel (II) chloride

b. Mohr's salt (Ferrous Ammonium sulphate)

c. Sodium trioxalato ferrate trihydrate

d. Sodium cobaltinitrite

e. Tetra amine cupric sulphate

f. Reineck's salt (Ammonium Tetrathiocyanate Diammine Chromate)

References:

1. Textbook of practical inorganic chemistry – A.I. Vogel
2. Practical Chemistry by Dr O. P. Pandey, D. N. Bajpai, Dr. S. Giri.
3. Advance inorganic analysis by Agarwal, Keemti lal.

4. Qualitative Inorganic analysis – Vogel.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1.		√		√	√	√					
2.		√		√	√	√					
3.		√		√	√	√					
4.		√		√	√	√					
5.		√		√	√	√					

M. Sc. (CHEMISTRY) SEMESTER I

Practical Core Course-2

COURSE NAME: PRACTICAL ORGANIC CHEMISTRY-I

COURSE CODE: CHEMSC-S1PR2-2CR26 [CREDITS – 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Demonstrate basics of separation of organic tertiary mixtures. Establish mechanism and monitor a reaction at specified condition.
2. Identify chemical nature of mixture.
3. Identify each component through their functional group test, elemental analysis and M.P/BP.
4. Purify the compounds using different techniques including distillation, crystallization.
5. Record physical constants for individual compounds and perform good laboratory practices.

Learning Objectives

This module is intended to

- Impart basic knowledge for the separation of organic ternary mixture
- Identify nature of mixture i.e., solid-solid, solid-liquid, liquid- liquid etc.
- Impart knowledge of different purification techniques including distillation
- Learn separation and identification of component with their functional group test and M.P. /B.P.
- Confirm the structure and prepare the relevant derivative

Contents

1. **Mixture analysis:**

   Tertiary mixture to be given. (S+S+S), (L+L+L), (S+S+L), (S+L+L). Type determination, Separation by physical and chemical methods. (both permitted in case of liquids)

2. **Paper Chromatography**:

   Chromatographic separation of amino acid mixture (Three amino acids) by ascending paper chromatography

References:

1. A text book of practical organic chemistry – A. I. Vogel.
2. Practical organic Chemistry – Mann and Saunders.
3. A handbook of quantitative and qualitative analysis – H. T. Clarke.
4. Comprehensive Practical Organic Chemistry : Qualitative Analysis V K Ahluwalia & S. Dhingra.
5. Comprehensive Practical Organic Chemistry : Preparations and Quantitative Analysis V K Ahluwalia& R. Aggarwal Universities Press.
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1.		√		√	√	√					
2.		√		√	√	√					
3.		√		√	√	√					
4.		√		√	√	√					
5.		√		√	√	√					

M. Sc. (CHEMISTRY) SEMESTER I
Practical Core Course-3

COURSE NAME: PRACTICAL PHYSICAL CHEMISTRY-I

COURSE CODE: CHEMSC-S1PR3-2CR26 [CREDITS - 02]

Course Learning Outcome

After the successful completion of the Course, the learner will be able to:

1. Inspect the rate of reactions in chemical kinetics.
2. Utilize knowledge of preparation of solutions.
3. Demonstrate use of pH-meter, potentiometer, and colorimeter.
4. Determine the molecular weight of polymer.
5. Analyse and interpret the tertiary phase diagram.

Learning Objectives

- To study the rate constant of chemical reaction
- To understand pH metric and potentiometric titrations
- To study the properties of surfactant and polymer in aqueous solution
- To determine the concentration of solution by colorimetry
- To understand the conductivity behavior of electrolytic solution
- To understand phase behaviour of three component system

Contents

1. Determine the dissociation constants of a given dibasic acid pH-metrically.
2. Determine the amount of ferrous sulphate / ferrous ammonium sulphate and Formal redox potential potentiometrically using cerric salt solution.
3. Verification of Onsager's equation and determination of equivalent conductance at infinite dilution of strong electrolytes
4. Calculate the molar absorptivity of each of the given two solutions (A) and (B) and also find out concentration of supplied unknown solution colorimetrically.
5. Investigate the reaction between $K_2S_2O_8$ and KI at two different temperatures and calculate the energy of activation for the reaction.
6. To study the phase diagram of a three-component system Water – acetic acid – chloroform.
7. Determine the molecular weight of a given polymer from viscosity measurement.
8. Determine CST of Phenol -Water system
9. Determine CST of Phenol –NaCl system

References:

1. Advanced Practical Physical Chemistry by Yadav J. B., Krishna Prakashan Media.
2. Practical Physical Chemistry, Dr. M. Satish Kumar Sankalp Publication.
3. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Specific Outcomes										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1.		√		√	√	√					
2.		√		√	√	√					
3.		√		√	√	√					
4.		√		√	√	√					
5.		√		√	√	√					