Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

(Autonomous)

Department of Chemistry

Syllabus of M. Sc. Part I- Chemistry

With Effect From June- 2018

GENERAL OBJECTIVES OF THE COURSE:

1. To educate and prepare post graduate students from rural and urban area who will get employment on large scale in academic institutes, R & D and Quality control laboratories of Indian chemical/pharmaceutical industries as well as multinational and forensic Laboratories.
2. To provide students with broad theoretical and applied background in all specialization of Chemistry with emphasis on qualitative and quantitative technique.
3. To provide broad common frame work of syllabus to expose our young graduates to the recent and applied knowledge of interdisciplinary branches of chemistry involving applied organic, inorganic, physical, analytical, industrial, pharmaceutical, polymer, nano science & technology.
4. To conduct lesser written tests and to encourage on non-written tests.
5. To focus on encouraging students to conduct various academic activities like midterm tests, online tests, open book tests, tutorial, surprise test, oral, seminar, assignments and seminar presentation.

Learning outcomes:

1. A graduate with a Master's degree in Chemistry has in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of chemistry.
2. The graduate has expert knowledge of a well-defined area of research within chemistry. The graduate has specific skills in planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques. Skilled in examining specific phenomena theoretically and/or experimentally, the graduate is able to contribute to the generation of new scientific insights or to the innovation of new applications of chemical research.

STRUCTURE OF COURSE: SEMESISTER

Semester	Paper No.	Title	Total Number of lectures/ practicals	Credits
Semester-I	**Theory Course**			
	MCT-101	Inorganic Chemistry	60 hrs	4
	MCT-102	Organic Chemistry	60 hrs	4
	MCT-103	Physical Chemistry	60 hrs	4
	MCT-104	Analytical Chemistry	60 hrs	4
	Practical Course			
	MCP-105	Chemistry Practical-I	15 Practicals	4
	MCP-106	Chemistry Practical-II	15 Practicals	4
Semester-II	**Theory Course**			
	MCT-201	Inorganic Chemistry	60 hrs	4
	MCT-202	Organic Chemistry	60 hrs	4
	MCT-203	Physical Chemistry	60 hrs	4
	MCT-204	Analytical Chemistry	60 hrs	4
	MCT-205	Applied Organic Chemistry	60 hrs	4
	Practical Course			
	MCP-206-III	Chemistry Practical-III	15 Practicals	4
	MCP -207-IV	Chemistry Practical-IV	15 Practicals	4
			Total Credits	**52**

- The semester examination will be conducted at the end of each term (both theory and practical examination)
- Theory paper will be of 70 marks each and 30 marks for internal evaluation test conducted in the mid of the term. Two practicals will be of 100 marks each.
- Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

Laboratory Safety Equipment's:

Part: I Personal Precautions:

1. All persons must wear safety Goggles at all times.
2. Must wear Lab Aprons/Lab Jacket and proper shoes.
3. Except in emergency, over – hurried activities is forbidden.

4. Fume cupboard must be used whenever necessary.
5. Eating, Drinking and Smoking in the laboratories strictly forbidden.

Part: II: Use of Safety and Emergency equipment:

1. First aid Kits
2. Sand bucket
3. Fire extinguishers (dry chemical and carbon dioxide extinguishers)
4. Chemical Storage cabinet with proper ventilation
5. Material Safety Date sheets.
6. Management of Local exhaust systems and fume hoods.
7. Sign in register if using instruments.

M. Sc. Part – I (Semester – I)

Paper MCT-101: Inorganic Chemistry

UNIT I Chemistry of Transition Elements [15]

General characteristics; Properties of transition elements, coordination chemistry of transition metal ions; Stereochemistry of coordination compounds; Ligand field theory; Splitting of d orbitals in octahedral, tetrahedral, square planner and square pyramidal environments; Jahn-Teller effect; Interpretation of electronicspectra including charge transfer spectra and D-D spectra using terms, state, microstate, Spectrochemical series.

R1: 146-149, 201-219, 232-234, 353, 653-661.
R2: 130, 137, 350-353, 515-624, 729-732, 749-755, 759, 766-769, 772-773, 795, 838-839, 882, 1006-1008, 1013, 1014, 1015.
R3: 220-226, 227-236, 444-448, 646-647, 659.

Unit II A] Stereochemistry and Bonding in Main Group Compounds [08]

VSEPR theory and drawbacks; pπ−pπ, pπ−dπ bonds; Walsh diagram, Bent rule;Back bonding effect with molecules containing N, O, F atom, Simple reactions of covalently bonded molecules (atom inversion, substitution reaction, photochemical reaction, Berry Psuedo-rotation).
R1: 3-27, 74-81, 90-96,112-117.
R2: 1-2, 9-12, 14, 16-22, 40, 198-218, 356-357, 774-779.
R3: 11, 74-77.

B] Bioinorganic Chemistry [07]

Role of metal ions in biological processes; Structure and properties of haemoglobin and myoglobin; Cytochromes, Ferrodoxins and Sulphur proteins; Ion transport across the membranes; Biological nitrogen fixation.
R1: 749-755, 759, 766-769, 772-773, 795, 838-839, 882, 1006-1008, 1013, 1014, 1015.
R2: 220-226, 227-236, 444-448, 646-647, 659.

UNIT III: Electronic, Electric and Optical behaviour of Inorganic materials [15]

Metals, Insulators and Semiconductors; band theory; Intrinsic and extrinsic semiconductors with their conduction mechanism; the band gap and it's calculations; temperature dependence of conductivity; carrier density and carrier mobility in semiconductors; synthesis by chemical vapour deposition (CVD) and chemical bath deposition (CBD) of semiconducting materials; single crystal growth, zone refining; semiconductor devices, rectifier transistors, photoconductors; photovoltaic cells; solar batteries.

R2: 255-257.

R3: 110-112.

UNIT IV: Nanoscience and Nanomaterials [15]

Introduction to nanoscience and nanotechnology; historical background; Classification of nanomaterials: 1D, 2D, 3D (with their examples); Applications of nanotechnology & Nanomaterials; Implications of nanotechnology; Future fantasy and nanotechnology; Experimental methods for preparation of nanomaterials: Chemical and Physical; Size dependent properties of nanoparticles;Characterization techniques for nanomaterial: Principle instrumentation and application of X-ray diffraction (XRD), Scanning electron microscopy (SEM),transmission electron microscopy (TEM)

R4: 694-695, 909-911, 918-920, 925-934.

R5: 857-860, 864-866, 870-875, 879-886.

References

1. J. D. Lee, Concise Inorganic Chemistry, John Wiley & Sons, 5th edition, 2009
2. B. R. Puri, L. R. Sharma and K. C. Kalia, Principals of Inorganic Chemistry, 2007-2008.
3. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, Oxford, 3rd edition, 1999.
4. L. E. Smart, E. A. Moore, Solid State Chemistry: An Introduction.
5. T. Pradeep, Nano The Essentials: Understanding Nanoscience and Nanotechnology.
6. J. H. Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York, 1972.
7. ManasChanda, Atomic Structure and Chemical bonding,
8. M. N. Hughes, Inorganic Chemistry of Biological Processes,
9. F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry,
10. N. N. Greenwood and A. Earnshaw, Chemistry of elements, Pergamon,
11. B. N. Figgis and M. A. Hitachman, Ligand field theory and its application, (2000) Wiely VCH publication.
12. Martel, Coordination chemistry.
13. Jones, Elementary co-ordination chemistry.

14. S. J. Lippard, J. M . Berg, Principles of bioinorganic Chemistry, University Science books.
15. R. J. P. Williams and F. R. Desalnia, Biological chemistry of the elements.
16. A. F. Wells, Structural Inorganic Chemistry – 5th edition, 1984.
17. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP,
18. A. H. Hanney, Solid State Chemistry, A. H. Publications,
19. O. A. Phiops, Metals and Metabolism,
20. S. J. Lippard, J. M. Berg, Principles of bioinorganic Chemistry, University Science Books,
21. G. L. Eichhron, Inorganic Biochemistry, Vol I and II, Elesevier,
22. Progress in Inorganic chemistry, Vol 18 and 38, J. J. Loppard, Wiley,
23. G. Zhong Cao. Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press (2004).
24. M. Ratner & D. Ratner. Nanotechnology: A Gentle Introduction to the Next Big Idea, Pearson Education (2003).

Learning outcomes

UNIT I: Chemistry of Transition Elements

1) Student should understand chemistry of transition elements for their coordination compounds.
2) Student should understand different theories for coordination compounds.
3) Student should know role of ligands incoordination compounds.
4) Student should know applications of coordination compounds.

UNIT II: A] Stereochemistry and Bonding in Main Group Compounds

1) Student should understand difference between classical chemistry and modern chemistry.
2) Student must explore conceptual fact of atom and molecule, understanding formation of atomic orbital and behaviour of electron in atom.
3) Student should understand different bond formation.
5) Student should know reactions of covalent molecules.

B] Bioinorganic Chemistry

1) Student should know role of elements in biological processes.
2) Student must know the metalloprotiens in body, transport process and biomogical nitrogen fixation process

UNIT III: Electronic, Electric and Optical behaviour of Inorganic materials

1) They must explain different inorganic materials type.
2) They should explain structure of semiconductors.
3) They should understand carrier mechanism in semiconductors.
4) They should know different process for purification of semiconductors.
5) They should know applications of semiconductors.

6) They should explain molecular orbital diagram of homonuclear and heteronuclear molecules.

UNIT IV: Nanoscience and Nanomaterials

1) They must know nanoscience and nanotechnology.
2) They should explain applications of nanotechnology.
3) They should understand different nanomaterials.
4) They should know future fantasy of nanomaterials.
5) They should know experimental methods for synthesis of nanomaterials.
6) They should know characterization techniques and properties of nanomaterials.

Paper MCT-102: Organic Chemistry

Unit-I: Reaction Mechanism: Structure and Reactivity (15)

a) Types of reactions, Chemical bonding and basis of reactivity- Chemical bond, delocalization, conjugation, resonance, hyper conjugation, tautomerism, inductive effects.

b) Acidity and basicity: various structural effects, hard and soft acid and base concept.

c) Aromaticity: Structural, thermochemical, and magnetic criteria for aromaticity, including NMR characteristics of aromatic systems. Benzenoid and non-benzenoidcompounds,Huckels rule, antiaromaticity, Application to carbocyclic and heterocyclicsystems,nulenes, azulenes, tropyliumcations, metallocenes , current concepts of aromaticity.

d) Structure and stability of reactive intermediates, carbenes, nitrenes, carbocations, carbanions and free radicals.

R1- 14-21, 68-72, 275
R2- 122-131, 148, 152

UNIT-II: A) Aliphatic Nucleophilic substitutions: (7)

The SN2, SN1 and SNi reactions with respects to mechanism and stereochemistry. Nucleophilic substitutions at an allylic, aliphatic trigonal, benzylic, aryl and vinylic carbons. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. SN reactions at bridge head carbon, competition between SN1 andSN2, Ambident nucleophiles, Neighbouring Group Participation.

B) Aromatic Electrophilic Substitutions (8)

Introduction, the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in aromatic systems, energy profile diagrams. The ortho/para ratio, ipso attack, concept of aromaticity, orientation in their ring systems. Diazo-coupling, Vilsmeier reaction, Von Richter rearrangement.

R1- 130-167, 31-45, 77-102
R11 – 121-149, 255-277

UNIT-III: A] Addition reactions (7)

Addition to C-C multiple bonds - mechanism and stereochemical aspects of addition reaction involving electrophile, nucleophile and free radicals, Regio and chemoselectivity, orientation and reactivity, conjugate addition.

B) Elimination Reactions: (8)

The E1, E2 and E1cB mechanisms.Orientation in Elimination reactions.Hoffman Versus Saytzeff elimination, competition between substitution and elimination reactions, Reactivity: effects of substrate structures, attacking base, the leaving group, the nature of medium on elimination reactions. Pyrolytic elimination reactions.Pyrolytic elimination: Chugaev reaction, Cope reaction and Pyrolysis of acetates.

R1- 248- 260, 381, 268, 340
R2- 573-583, 672
R3 – 335,336,420,610

UNIT-IV Stereochemistry (15)

Symmetry operations: Rotation, reflection, inversion, rotation- reflection. Identification of the different axes and planes of symmetry.

Molecules with two or more chiral centers: Configurational nomenclature

Constitutionally unsymmetrical molecules: Erythro-Threo and Syn-Anti systems.

Constitutionally symmetrical molecules with odd and even number of chiral centres:

enantiomeric and meso forms, concept of stereogenic, chirotopic and pseudoasymmetric centres.

Axial and planar chirality: Principles of axial and planar chirality. Stereochemical features and configurational descriptors (R, S) for the following classes of compounds: allenes, alkylidene cycloalkanes, spiranes, biaryls (including BINOLs and BINAPs),

Prochirality: Homotopic, heterotopic and diastereotopic ligands and faces. Identification using substitution and symmetry criteria.Nomenclature of stereoheterotopic ligands and faces. Symbols for stereoheterotopic ligands in molecules with one or more prochiral centres, pro-pseudoasymmetric centre, chiral and prochiral centre; prochiral axis and prochiral plane. Symbols for enantiotopic and diastereotopic faces.

R7- 120-132, 325-367
R17- 30-72, 168-205

References:

1. A guide book to mechanism in Organic chemistry (Orient-Longmens)- 6th edition Peter Sykes
2. Organic Reaction Mechanism (Benjamin) R. Breslow
3. Organic Chemistry-7th edition R. T. Morrison and R. N. Boyd,(Prentice Hall.)
4. Mechanism and Structure in Organic chemistry (Holt Reinh.)B. S. Gould.
5. Organic Chemistry(McGraw-Hill)Hendrikson, Cram and Hammond.

6. Reactive Intermediates in Organic Chemistry (John Wiley)N. S. Issacs.
7. Stereochemistry of Carbon compounds. (McGraw-Hill)E.L.Eliel
8. Organic Stereochemistry (McGraw-Hill) by Hallas.
9. Organic Reaction Mechanism (McGraw-Hill) R. K. Bansal.
10. Basic principles of Organic Chemistry (Benjamin) J. D.Roberts and M. C.Caserio
11. Modern Organic Reactions(Benjumin) H. O. House.
12. Principle of organic synthesis- R.O.C. Norman and J. M. Coxon.(ELBS)
13. Reaction Mechanism in Organic Chemistry- S. M. Mukharji and S. P. Singh.
14. Stereochemistry of Organic compoundsc) D. Nasipuri.
15. Advanced Organic Chemistry (McGraw-Hill) J. March.
16. Introduction to stereochemistry(Benjumin) K. Mislow.
17. Stereochemistry by P. S. Kalsi (New Age International)

Learning outcomes

Unit-I: Reaction Mechanism: Structure and Reactivity

1) Student should understand organic reaction mechanism with respect to structure and reactivity.
2) Student must explore conceptual fact of Chemical bonding and basis of reactivity.
3) Understanding formation of atomic orbital through quantum approach.
4) They should knew energy level in atom using modern classical quantum mechanics.
5) They should understand behavior of electron in atom.

UNIT-II: A) Aliphatic Nucleophilic substitutions and B) Aromatic Electrophilic Substitutions

1) Student should understand formation of various types of Aliphatic Nucleophilic substitutions.
2) Student should compare The SN2, SN1 and SNi reactions with respects to mechanism and stereochemistry.
3) Student should know Ambident nucleophiles, Neighbouring Group Participation.
4) Student must explain Aromatic Electrophilic Substitutions.
5) Student must state approach of the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in aromatic systems.
6) They should demonstrate concept of aromaticity, orientation in their ring systems. Diazo-coupling, Vilsmeie reaction, Von Richter rearrangement.

UNIT-III: A] Addition reactions and B) Elimination Reactions

1) They must explain the Addition to C-C multiple bonds - mechanism and stereochemical aspects of addition reaction.
2) They should explain nucleophile and free radicals, Regio and chemoselectivity,
1) They should understand Regio and chemoselectivity, orientation and reactivity, conjugate addition

2) Student must explain E1, E2 and E1cB mechanisms. Orientation in Elimination reactions
3) Student must state approach of the Hofman versus Saytzeff elimination
4) They should demonstrate concept of Pyrolytic elimination: Chugaev reaction, Cope reaction and Pyrolysis of acetates.

UNIT-IV: Stereochemistry

1) Student should understand Symmetry operations: Rotation, reflection, inversion, rotation- reflection. Identification of the different axes and planes of symmetry.
2) Student should compare Principles of axial and planar chirality. Stereochemical features and configurational descriptors
3) Student should know Homotopic, heterotopic and diastereotopic ligands and faces.

Paper –MCT-103: Physical Chemistry

UNIT-I: Thermodynamics [15]

Introduction, Extensive and intensive properties.Rault'slaw. Duhem-Margules equation and its applications to vapor pressure curves (Binaryliquid mixture). Gibbs-Duhem equation and itsapplications to study of partial molar quantities.Henry'slaw.Thermodynamicsofnon-electrolytesolutions.Excess and mixing thermodynamic properties.Entropy and thirdlaw of thermodynamics.Methods of determining the practical absolute entropies.Entropies of phase transition.Maxwell relations, thermodynamic equation of state, chemical potential, variationof chemical potential with temperature &pressure.Equilibrium constants and generalconditions of equilibrium in terms of thermodynamic potentials.

R1. Physical Chemistry – P. W. Atkins, Oxford University press, 8th edition, 2006. Page No: 28-105

UNIT-II: Statistical Thermodynamics [15]

Introduction, terminology, thermodynamicprobability and entropy: Boltzmann – Planck equation. Ensembles, ensemble average andtime average of property. Maxwell-Boltzmann (MB) distribution law and its applicationto viscosity and diffusion of gases.Partition function and its significance.Rotational,translational, vibrational and electronic partition functions. Use of spectroscopic data forevaluation of various partitionfunctions.Relationship between partition function andthermodynamicproperties.Sackurtetrodeequation.Calculation of equilibrium constantusing Partition function.

R1 Statistical Mechanics – Donald A. McQuarrie, 2000 (entire book)

R2 Physical Chemistry – P. W. Atkins, Oxford University press, 8th edition, 2006. Page No: 560-620

R3 Elements of statistical thermodynamics - L. K. Nash, 2nd Ed. Addison Wesley 1974 (entire book)

UNIT-III: Biophysical Chemistry [15]

Introduction to biophysical chemistry: Amino acids, peptide, proteins, enzymes,nucleic acids: Introduction to primary, secondary, tertiary and quaternary structures, acidbase properties. Intermolecular forces: H- bonding, Van der Waals forces, Lenard-Jonespotential, columbic interactions, 1-4 interactions, hydrophobic hydration and interaction.Protein folding/defolding phenomena, use of spectroscopic and thermodynamic tools forprotein-ligand binding equilibrium study, hydrodynamic and equilibrium thermodynamicmethods for determination of molar mass of biological macromolecules.

R1 Biophysical Chemistry – J.P. Allen, Wiley-Blackwell, 2008. (entire book)
R2 Biophysical Chemistry – A. Cooper, RSC, 2004. (entire book)

UNIT- IV: Molecular Spectroscopy [15]

1. Recapitulation: Width and intensity of spectral transitions, Forier transform, microwave spectroscopy, rotation spectra of di – and poly- atomic molecules, Stark effect.
2. Electronic spectroscopy of molecules: Born – Oppenheimer approximation, electronic spectra of diatomic molecules, molecular photoelectron spectroscopy, application.
3. Infra- red spectroscopy: Harmonic and anharmonic oscillator, types of vibrational spectra of di – and poly- atomic molecules, application.
1. Raman Spectroscopy: Introduction, theory of Raman Effect, structure elucidation from combined Raman and IR spectroscopy, applications in structure elucidation.

R1. Physical Chemistry – P. W. Atkins, Oxford University press, 8th edition, 2006. Page No: 481-557
R2.Fundamentals of molecular spectroscopy : C.N. Banewell and E.Mc. Cash (Fourth edition). (entire book)

References

1. Physical Chemistry – P. W. Atkins, Oxford University press, 8th edition, 2006.
2. Text book of Physical Chemistry – S. Glasstone.
3. Principles of Physical Chemistry – Marron and Pruton.
4. Physical Chemistry – G. M. Barrow, Tata-McGraw Hill, Vth edition, 2003.
5. Thermodynamics for Chemists – S. Glasstone, D. Van Nostrand , 1965.
6. Thermodynamics: A Core Course- R. C. Srivastava, S. K. Saha and A. K. Jain, Prentice-Hall of India, IInd edition, 2004.
7. Elements of statistical thermodynamics - L. K. Nash, 2nd Ed. Addison Wesley 1974.
8. Theoretical Chemistry: An introduction to quantum mechanics, statistical mechanics, and molecular spectra for chemists - S. Glasstone, D. Van Nostrand Company, Inc., 1944.
9. An Introduction to Statistical Thermodynamics – T.L. Hill, Addison-Wesley. 1960.

10. Statistical Mechanics – Donald A. McQuarrie, 2000.
11. Physical chemistry of surfaces – A. W. Adamson, 4th Ed. John Wiley, 1982.
12. Introduction to Colloid and Surface Chemistry – D. Shaw, Butterworth Heinemann, 1992.
13. Surface Activity: Principles, Phenomena and Applications (Polymers, Interfaces and Biomaterials) – K. Tsujii, 1st Ed. Academic Press, 1998.
14.Biophysical Chemistry – J.P. Allen, Wiley-Blackwell, 2008.
15.Biophysical Chemistry – A. Cooper, RSC, 2004.
16. Thermodynamics of Biochemical Reactions – R.A. Alberty, Wiley-Interscience, 2003.
17. Textbook of Biophysical Chemistry – U.N. Dash, McMillan India, 2006.
18. Fundamentals of molecular spectroscopy : C.N. Banewell and E.Mc. Cash (Fourth edition).

Learning outcomes

UNIT-I: Thermodynamics

1) Student should understand difference between classical thermodynamics and modern thermodynamics
2) Student must explore applications of ideal solution and non-ideal solutions.
3) Understanding entropy and its application.
4) They should knewequilibrium and equilibrium constants.
5) They should understand Maxwell relations.

UNIT-II: Statistical Thermodynamics

1) Student should compare formation of ensembels.
2) Student should know formation and energetics of Rotational, translational, vibrational and electronic partition functions.
3) They should explain Boltzmann – Planck equation. Ensembles, ensemble average and time average of property
4) Student must explain Sackurtetrode equation.

UNIT-III: Biophysical Chemistry

1) Student must explain formation of primary, secondary, tertiary and quaternary structures.
2) Student must state approach of molecule formation through , Van der Waals forces, Lenard-Jones potential.
3) They should demonstrate hydrodynamic and equilibrium thermodynamic methods for determination of molar mass of biological macromolecules

UNIT- IV: Molecular Spectroscopy

1) They must explain the formation of Recapitulation.
2) They should explain Infra- red spectroscopy method, Born – Oppenheimer approximation
3) They should understand Raman Spectroscopy: Introduction, Rotational Raman spectra, Vibrational Raman Spectra, polarization of light and Raman effect.

4) They should explain, Rotational Raman spectra, Vibrational Raman Spectra, polarization of light and Raman effect.

Paper MCT-104: Analytical Chemistry

UNIT-I: Errors and treatment of Analytical Chemistry [15]

Errors, Determinant, constant and indeterminate.Accuracy and precision, Distribution of random errors.Average deviation and standard deviation, variance and confidencelimit.Significance figures and computation rules.Least square method. Methods of sampling: samples size. Techniques of sampling of gases, fluid, solids, and particulates.

UNIT-II: Chromatographic methods [15]

General principle, classification of chromatographic methods.Nature of partition forces.Chromatographic behaviour of solutes.Column efficiency and resolution. Gas Chromatography: detector, optimization of experimental conditions. Ion exchanges chromatography. Thin layer chromatography: coating of materials, prepative TLC. Solvents used and methods of detection Column chromatography:Adsorption and partition methods. Nature of column materials.
Preparation of the column.Solvent systems and detection methods.

UNIT-III: Fluorimetry and Phosphometry [15]

Introduction, Comparison of absorption and fluorescence methods,Theory, Instrumentation, applications of fluorimetry, Applications of Phosphometry, Comparison of Fluorimetry and Phosphometry.

UNIT-IV: Computer Science [15]

Introduction,History, Hardware: Central processor unit. Input devices. Storage devices.Periferals, Software: Overview of the key elements of basic program structure, loops, arrays, mathematical function. User defined functions, conditional statements, string. Applications. Data representation, Computerized instruments system. Microcomputer interfacing

References:

1. Analytical Chemistry: (J.W) G. D. Christain
2. Introduction to chromatography :Bobbit
3. Instrumental Methods of analysis (CBS)- H.H . Willard, L.L. Mirrit, J.A. Dean
4. Instrumental Methods of Analysis :Chatwal and Anand
5. Instrumental Methods of Inorganic Analysis(ELBS) : A.I. Vogel
6. Chemical Instrumentation: A Systematic approch- H.A. Strobel
7. The principals of ion-selective electrodes and membrane transport: W.E.Morf
8. Physical Chemistry – P.W.Atkins

9. Principal of Instrumental Analysis- D. Skoog and D.West
10. Treatise on Analytical Chemistry: Vol Ito VII – I.M. Kolthoff
11. Computer, Fundamentals-P.K.Sinha
12. Programming in BASIC : E. Balaguruswamy
13. Computer programming made simples :J.Maynard.
14. Instrumental methods of chemical analysis-H.K. Kaur
15. Instrumental methods of chemical analysis-Chatwal and Anand
16. Instrumental methods of chemical analysis-B.K. Sharma

Learning Outcomes

UNIT-I: Errors and treatment of Analytical Chemistry

1) Student should understand Errors, Determinant, constant and indeterminate. Accuracy and precision Distribution of random errors.
2) Student must explore conceptual fact of Average derivation and standard derivation, variance and confidence limit. Significance figures and computation rules.
3) Student should understand Least square method. Methods of sampling: samples size.

UNIT-II: Chromatographic methods

1) Student should understand General principle, classification of chromatographic methods. Nature of partition forces.Chromatographicbehavior of solutes.
2) Student should know Column efficiency and resolution. Gas Chromatography: detector, optimization of experimental conditions. Ion exchanges chromatography.
3) Student must know the Solvent systems and detection methods.

UNIT-III: Fluorimetry and Phosphometry

1) Student must know Comparison of absorption and fluorescence methods.
2) Student must know Instrumentation, applications of fluorimetry.
3) Student should know Comparison of Fluorimetry and Phosphometry.

UNIT-IV: Computer Science

1) They must explain Hardware: Central processor unit. Input devices. Storage devices.
2) They should explain Software: Overview of the key elements of basic program structure, loops, arrays, mathematical function.
3) They should understand User defined functions, conditional statements, string Applications.

Practical -I MCP-105 - I

A) Inorganic Chemistry

1. Ore analysis – '1' ores (Iron ore, Pyrolusite ore)
2. Alloy analysis – '1' (Monel, Brass)
3. Inorganic Preparations and purity
    a. Hexaaminenickel (II) chloride
    b. Hexaammine cobalt (III) chloride

c. Potassiumtrioxalatochromate (III)
d. Carbonatotetraammine cobalt (III) nitrate
e. Hexathioureaplumbus nitrate
f. Trinitrotriammine cobalt (III)

Reference:

1. A text book of Quantitative Inorganic Analysis – A. I. Vogel
2. Experimental Inorganic Chemistry - W. G. Palmer
3. The analysis of minerals and ores of the rarer elements – W. R. Schoeller and A.R. Powell, Charles, Griffin and Company Limited
4. I. M. Kolthoff, V. J. Elving and Sandell, "Treatise on Analytical Chemistry", Interscience.
5. I. M. Kothoff and Strenger, "Volumetric Analysis", Interscience
6. Fruman and Welcher, "Standard Methods of Inorganic Analysis", Van Nostrand
7. G.Schwarzenback, "Complexomtric Titrations", Interscience
8. D.A.Skoog and D.M.West, "Analytical Chemistry – An Introduction", Reinholdt.
9. R.S.Drago, "Physical Methods in Inorganic Chemistry", Affiliated East-West Press

Learning Outcomes

1) Student should understand the practical's of Inorganic Chemistry.
2) Student must explore different ore and alloy analysis of different metal compositions.
3) Student should understand preparations and purity of inorganic chemistry.

Practical- I MCP-105- I

B) Organic Chemistry

A) Preparations

(One stage preparations involving various types of reactions)

1.Oxidation: Adipic acid by chromic acid oxidation of Cyclohexanol.
2.Aldol condensation: Dibenzal acetone from Benzaldehyde.
3.Sandmeyer reaction: p- Chlorotoulene from p-Toluidine.
4.Cannizzaro reaction: 4-chlorobenzyldehyde as a substrate.
5.Aromatic Electrophilic substitutions: Synthesis of p-Nitroaniline and pBromoaniline.
6.Preparation of Cinnamic acid by Perkin's reaction.
7.Knoevenagel condensation reaction
8.Coumarin Synthesis
9.Synthesis of Heterocyclic compounds.
10. Synthesis of Dyes
11. Determination of percentage of Keto-enol form.

B)Estimations:

1.Estimation of formalin.
2.Colorimetric Estimation of Dyes
3.Estimation of Amino acids

(Any suitable Expt. may be added.)

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.Organic Synthesis Collective Volumes by Blat.

Learning outcomes

1) Student should understand variety of applications of name reactions.
2) Student should know the estimations and preparations of organic compounds.
3) Student should learn number of organic synthesis.

Practical –II MCP-106-II

A) Physical Chemistry

Students are expected to perform 15-20 experiments of three and half hours duration.

Experiments are to be set up in the following techniques.

1. Potentiometry:

Determination of solubility and solubility product of silver halides, determination of binary mixture of weak and strong acid etc.

2. Conductometry :

i) Determination of mixture of acids and relative strength of weak acids.
ii) Hydrolysis of ethyl acetate by NaOH using conductometric measurements.
iii) Determination of ΔG, ΔH, and ΔS of $BaSO_4$ by conductometry.

3.Spectrophotometry

Study the kinetics of iodination of acetone spectrophotometrically.

4Refractometry :

Determination of molecular radius of molecule of organic compound.

5Polarimetry :

Kinetics of inversion of cane sugar in presence of strong acid.

6 Chemical Kinetics :

Kinetics of reaction between bromate and iodide.

7 Partial Molar Volume :

Determination of PMV by intercept method, density measurements etc.(New experiments may also be added)

References:

1 Findlay's Practical Chemistry – Revised by J.A. Kitchner (Vedition)
2 Text Book of Quantitative inorganic analysis : A.I. Vogel.21
3 Experimental Physical Chemistry :R.C.Das and B. Behera

4 Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan
5 Experimental Physical Chemistry :V.D. Athawale and ParulMathur.
6 Systematic Experimental Physical Chemistry :S.W. Rajbhoj and T.K.Chondhekar

Learning outcomes

1) Student should understand variety of instrumentation techniques..
2) Student should know the spectrophotometric experiments.
3) Student should learn chemical kinetics of the reaction.

Practical- II MCP-106-II

B) Analytical chemistry

Physical Chemistry Section

1) To verify Beer-Lambert's Law for potassium permanganate solution and hence To determine the molar extinction coefficient and unknown concentration of given samplecolorimetrically
2) To determine the solubility of calcium oxalate in presence of KCl(Ionic Strength Effect)
3) To determine the solubility of calciuum oxalate in presence of HCl(H+ ion Effect)

Organic Chemistry Section

1 Analysis of Pharmaceutical tablets.
2 To verify the Beer-Lamberts Law and determine the concentration of given dye solutioncolorimetrically.
3 To estimate the amount of D-glucose in given solution colorimetrically.
4 To determine the acid value of given oil

Inorganic Chemistry Section

1 Determination of sodium from the fertilizer sample using cation exchange chromatographically.
2 Determination of calcium from given drug sample.
3 Determination of hardness, alkalinity and salinity of water sample
4 Separation and estimation of chloride and bromide on anion exchanger.

Learning Outcomes

1) Student should understand the practical's of Physical, Inorganic and Organic Chemistry with respect to analytical Chemistry.
2) Student must explore different concepts of practicals in three different disciplines of chemistry.
3) Student should understand applications of experimental chemistry through analytical chemistry.

M. Sc. Part – I (Semester – II)

Paper MCT-201: Inorganic Chemistry

UNIT I: Chemistry of Non–Transition Elements [15]

Introduction, Polymorphism in carbon, phosphorous and sulphur, Synthesis, properties and structure of halides, oxides, boranes, carboranes, silicates, carbides, phosphazenes, Sulphur–Nitrogen compounds, Peroxo compounds (boron, carbon, sulphur), Structure and bonding in oxyacids of nitrogen, phosphorous, sulphur and halogens, interhalogens, pseudohalides.

R1: 290-291, 295-297, 338-346, 416-425, 428-443, 498-405, 556-563, 572-575, 614-631, 643-647.

R2: 402-404, 406-408, 418-420, 438-440, 450-452, 454, 461, 467-470, 490-507, 541-544, 548-550, 566-571, 586.

R3:151-153, 162-164, 270, 345-350, 352, 361, 366-369, 378, 392, 398, 412.

UNIT II: Organometallic Chemistry [15]

Organometallic Compounds: Classification, Synthesis, Properties, Uses and Structure, Electron count for different types of organometallic compounds, 18 and 16 electron rule exceptions, organometallic reagents in organic transformations (Hydrogenation, hydroformylation, isomerisation and polymerisation)

UNIT III: A] Studies and Applications of Lanthanides and Actinides [07]

Spectral and magnetic properties, Use of lanthanide compounds as shift reagents, Modern methods of separation of lanthanides and actinides, industrial applications.

R1: 857-860, 864-866, 870-875, 879-886.

R2: 704-705, 708-709, 710-714, 714, 715-718.

R3: 320-326, 454, 570.

B) Nuclear and radiochemistry [08]

Nuclear stability and factors affecting it; Radioactive decay and equilibrium, Q value, cross-sections, types of nuclearreactions, fission and fusion, Applications of nuclear chemistry.

R1: 694-695, 909-911, 918-920, 925-934.

R2: 932, 948-953, 957-959, 981, 1048-1050, 1056-1059, 1061-1063, 1070.

R3: 570.

UNIT IV: Group Theory and Molecular Symmetry [15]

Symmetry operations, symmetry elements, sub-elements (or sub-group), point-group and its classification, Group-multiplication taste (C_{2v}, C_{3v}, D_{2h}), matrix representation of symmetry elements, Great orthogenality theorem, Redouble and irreducible representations, character table (C_{2v}, C_{3v}), properties of IRs, Direct product and standard reduction formula.

References

1. J. D. Lee, Concise Inorganic Chemistry, John Wiley & Sons, 5th edition, 2009
2. B. R. Puri, L. R. Sharma and K. C. Kalia, Principals of Inorganic Chemistry, 2007-2008.

3. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, Oxford, 3rd edition, 1999.
4. T. Pradeep, Nano The Essentials: Understanding Nanoscience and Nanotechnology.
5. J. Schulte, Nanotechnology: Global Strategies, Industry Trends and Applications.
6. Ligand field theory and its application, B. N. Figgis and M. A. Hitachman (2000) Wiely VCH publication.
7. R. L. Datta and Syamal, Elements of magneto chemistry, Second edition, East west press pvt ltd. 2007.
8. B. P. Level, Inorganic Electronic Spectroscopy, second edition 1984, Elsevier Science publisher New York.
9. A. F. Wells, Structural Inorganic Chemistry – 5th edition, 1984.
10. J. H. Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and
11. Row Publisher, Inc. New York, 1972.
12. Jones, Elementary coordination chemistry
13. ManasChanda, Atomic Structure and Chemical bonding,
14. F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry,
15. P. L. Pauson, Organometallic chemistry
16. H. S. Sisler Chemistry in non aqueous solvent, Reinhold Publisher corporation, USA.
17. G. Schmid, Nanotechnology, Volume 1: Principles and Fundamentals.
18. L. E. Smart, E. A. Moore, Solid State Chemistry: An Introduction.
19. C. Kittel, Introduction to solid state Physics.
20. F. A. Cotton, Chemical applications of Group Theory, Third ed, John Wiley &Sons, Canada,1990.
21. P. Kelly, Symmetry, Handout of CHEM201, Fall 2008.
22. E. Wiberg, N. Wiberg, A. F. Holleman, Inorganic Chemistry, Academic Press, 2001.

Learning outcomes

UNIT I: Chemistry of Non–Transition Elements

1) Student should understand chemistry of non-transition elements for their coordination compounds.
2) Student should understand properties of the non–transition elements, Special features of individual elements.
3) Student should know Polymorphism in carbon, phosphorous and sulphur, Synthesis, properties and structure of boranes, carboranes, silicates, carbides, phosphazenes.
4) Student must know bonding in oxyacids of nitrogen, phosphorous, sulphur and halogens, interhalogens, pseudohalides.

UNIT II: A] Organometallic Chemistry

1) Student must explain formation of coordination compound and molecules.
2) Student must know bonding in organometallic compounds.
3) Student should know catalytic reactions of organometallic compounds.

UNIT III:A] Studies and Applications of Lanthanides and Actinides

1) They must explain Spectral and magnetic properties, Use of lanthanide compounds as shift reagents, Modern methods of separation of lanthanides and actinides.
2) They must know separation techniques of Lanthanides
3) They should explain Organometallic chemistry applications of lanthanide and actinide compounds in Industries.

B) Nuclear and radiochemistry

1) Student must know nuclear and radiochemistry of elements.
2) Student must know radioactive decay and nuclear reactions.
3) Student should know chemical effects of nuclear transformation and fission, fusion reactions.

UNIT IV: Group Theory and Molecular Symmetry

1) They must know Symmetry operations.
2) They should know point-group and its classification.
3) They should understand matrix representation of symmetry elements.
4) They should know Direct product and standard reduction formula.

Paper-MCT-202: Organic Chemistry

UNIT-I: A) Study of following reactions: (12)

Mechanism of condensation reaction involving enolatesMannich, Benzoin, Stobbe, Dieckmann, Robinson annulation,Chichibabin, Simon-Smith, Vlhmann, Mc-Murry, Dakin, Hoffman, Schmidt, Curtius, Lossen, Neberl and Prins, Ortaon, Hofmann-Martius and Demjanov reaction, Suzuki coupling reaction.

B) Alkylation and Acylation (03)

Introduction, Types of alkylation and alkylating agents: C-Alkylation and Acylation of active methylene compounds and their applications.

R1- Entire book
R2- 1541, 816, 901, 325, 725-746
R3- 111-115, 169-172

UNIT-II: A) Oxidation (08)

CrO_3, PDC, PCC, $KMnO_4$, MnO_2, Swern, SeO_2, $Pb(OAc)_4$,Pd-C, OSO_4, m-CPBA, O_3, $NaIO_4$, HIO_4, RuO_4, Etard oxidation, H_2O_2 and Peracid.

B) Reduction (07)

General mechanism, selectivity, and important applications of the following reducing reagents: Metal hydride reduction: Boron reagents (NaBH4, NaCNBH3, Na(OAc)3BH), Aluminium reagents (LiAlH4, DIBALH, Red Al), MPV reduction and reduction with H2/Pd-C, Wilkinson's catalyst and Wolff Kishner reduction.

R 1- 89-112, 151-167, 226-239
R2- 503, 1472-1487, 563-576, 489-497
R-3- 575-605

UNIT-III: A) Hydroboration : (05)

Mechanism and Synthetic Applications

B) Enamins: (05)

Formation and reactivity of enamines

C) Ylides: (05)

Phosphorus, Nitrogen and Sulphur ylides

R2- 1278-1283, 615-667,1275-1279, 1325-1339

R4- Entire book

UNIT-IV: Study of Organometallic compounds: (15)

Organo-lithium, organo cobalt, Fe, Ce, Ti, Cd. Use of lithium dialkylcuprate,their addition to carbonyl and unsaturated carbonyl compounds.

R2- 771-798, 209-223, 1251-1258

R3- 15-52

References:

1. A collection of detailed reaction mechanism-2nd edition- Jie Jack Li
2. Organic Chemistry- 1st edition- Clayden, Greeves, Warren and Wothers
3. Some modern methods of Organic synthesis-(Cambridge) W. Carruthares.
4.Hydroboration- S. C. Brown.
5.Advances in Organometallic Chemistry- (A.P.)F. C. A. Stone and R. West.
6.Organic Chemistry (Longman)Vol. I & Vol. II- Finar
7.Oxidation by-(Marcel Dekker) Augustin
8.Advanced Organic chemistry 2nd Ed. R R. Carey and R. J. Sundburg.
9.Tetrahydron reports in organic chemistry- Vol.1, No. 8.
10.Organic Synthesis-(Prentice Hall)R. E. Ireland.
11.Homogeneous Hydrogenation-(J. K.) B. R. James.
12.Comprehensive Organic Chemistry- (Pargamon) Barton and Ollis.
13.Organic reactions- various volumes- R. Adams.
14. Principles of organic synthesis-(Methuen) R. O. C. Norman
15.Modern synthetic reactions-(Benjamin) H. O. House.
16.Reagents in organic synthesis-(John Wiley) Fieser and Fieser

Learning outcomes

UNIT-I: A) Study of following reactions and B) Alkylation and Acylation

1) Student should understand organic reaction mechanism with respect to Mechanism of condensation reaction involving enolatesMannich, Benzoin, Stobbe, Dieckmann, Robinson annulation
2) Student must know the reaction Chichibabin, , Simon-Smith, Vlhmann, Mc-Murry, Dakin, Hoffman, Schmidt, Curtius, Lossen, Neberl and Prins, Ortaon, Hofmann-Martius and Demjanov reaction, Suzuki coupling reaction

3) Student must understand the Types of alkylation and alkylating agents: C-Alkylation andAcylation of active methylene compounds and their applications.

UNIT-II: A) Oxidation and B) Reduction

1) Student should explain mechanism of the reagents CrO_3, PDC, PCC, $KMnO_4$, MnO_2, Swern, SeO_2, $Pb(OAc)_4$,Pd-C, OSO_4, m-CPBA, O_3, $NaIO_4$, HIO_4, RuO_4, Etard oxidation, H_2O_2 and Peracid.
2) They should understand its role in organic synthesis.
3) They must explain General mechanism, selectivity, and important applications of the following reducing reagents: Metal hydride reduction: Boron reagents (NaBH4, NaCNBH3, Na(OAc)3BH), Aluminium reagents (LiAlH4, DIBALH, Red Al), MPV reduction.

UNIT-III: A) Hydroboration, B) Enamins andC) Ylides

1) They must explain the Mechanism and Synthetic Applications of hydroboration.
2) They must explain the formation and reactivity of enamines.
3) Students should understand the chemistry of Nitrogen and sulpher with respect to their ylides.

UNIT-IV: Study of Organometallic compounds

1) Student should explain the reaction and mechanism of Organo-lithium, organo cobalt, Fe, Ce, Ti, Cd.
2) They must understand applications of organometallic compounds in organic synthesis.

Paper-MCT-203: Physical Chemistry

UNIT- I: Quantum Chemistry [15]

Introduction: Operators and related theorems, algebra of operators, commutator,linear operators, uncertainty principle, postulate of quantum mechanics, properties ofwave functions, Schrodinger equation, wave function and its interpretation.Normalization and orthogonality, Eigen functions and Eigen values. Solutions of waveequation for a free particle and particle in a box problem.Transition dipole momentintegral and selection rules.Application to electronic spectra of conjugated linear organicmolecules. Linear and angular momentum, eigen function and eigen values of angularmomentum operator, Ladder operator, addition of angular momenta. Spin angularmomenta, symmetric and antisymmetricwavefunctions, Pauli Exclusion Principle,spectroscopic term symbols

R1 Principles of physical chemistry by Puri-Sharma-Pathania; Page No.21-110, 111-172

R2 Quantum Chemistry - R.K. Prasad, New Age International, New Delhi. Page No.1-100, 120-150

R3 Quantum Chemistry – Donald A. McQuarrie, Viva Books, New Delhi, 2003. (entire book)

UNIT-II: A] Photochemistry [08]

Absorption of light and nature of electronic spectra, electronic transition, FrankCondon principle, selection rules, photo-dissociation, pre-dissociation, Photo physicalphenomena: Electronic structure of molecules, molecular orbital, electronically excitedsinglet states, designation based on multiplicity rule, life time of electronically excitedstate, construction of Jablonski diagram, electronic transitions and intensity of absorptionbands, photo-physical pathways of excited molecular system (radiative and nonradiative),Photochemistry of environment: GreenhouseEffect.

B] Fluorescence [07]

Introduction, delayed fluorescence, and phosphorescence,fluorescence quenching: concentration quenching, quenching by excimer and exciplexemission, fluorescence resonance energy transfer between photo-excited donor andacceptor systems. Stern-Volmer relation, critical energy transfer distances, energytransfer efficiency, examples and analytical significance, bimolecular collisional quenching and Stern-Volmer equation.

R1 Principles of physical chemistry by Puri-Sharma-Pathania; Page No.1112-1146
R2 Photochemistry – J. G. Calverts and J. N. Pitts, John-Wiley & Sons (entire book)
R3 Fundamentals of Photochemistry- K. K. Rohatgi-Mukharjii, Wiley Eastern(entire book)

UNIT-III: Electrochemistry [15]

Debye - Huckel theory of inter-ionic attraction, ionic atmosphere, time ofrelaxation, relaxation and electro-phoretic effects, Debye-Huckel-Onsagar equation andits validity for dilute solutions and at appreciably concentrated solutions.Abnormal ionicconductance of hydroxyl and hydrogen ions. Activity coefficients: forms of activitycoefficients and their interrelationship. Debye-Huckel limiting law for osmotic andactivity coefficients of dilute electrolytic solutions and its applications to concentratedsolutions. Debye-Huckel-Bronsted equations. Quantitative and qualitative verification ofDebye-Huckel limiting law, Bjerrum theory of ion-ion association. Types of electrode,Determination of activity coefficients of an electrolyte using concentration cells, degreeof dissociation of monobasic weak acid (approximate and accurate), instability constantof silver ammonia complex.Acid and alkaline storage batteries.

R1 Electrochemistry- S. Glasstone, D. Van Nostrand , 1965 (entire book)
R2 Principles of physical chemistry by Puri-Sharma-Pathania; 46 th Edition Page No.835-881, 882-934

UNIT-IV: A] Chemical Kinetics [15]

Experimental methods of following kinetics of a reaction, chemical and physical(measurement of pressure, volume, EMF, conductance, diffusion current and absorbance)methods and examples. Steady state approximation and study of reaction between $NO_2$and F2, decomposition of ozone, and nitrogen pentoxide. Ionic reaction: Primary andsecondary salt effect, Homogeneous catalysis: acid and base catalysed

reactions,Michaelis–Menten enzyme catalysis. Heterogeneous catalysis: Adsorption of gas on asurface and its kinetics, Catalyzed hydrogen-deuterium exchange reaction.
R1. Chemical Kinetics-K. J. Laidler, Pearson Education,2004 Page No. 20-80, 100-180
R2 Principles of physical chemistry by Puri-Sharma-Pathania; 46 th Edition Page No.1033-1111

References:

1. Introductory Quantum Chemistry - A. K. Chandra. Tata McGraw-Hill. 1988.
2. Physical Chemistry: A molecular Approach – Donald A. McQuarrie and John D. Simon, Viva Books, New Delhi, 1998.
3. Quantum Chemistry – Donald A. McQuarrie, Viva Books, New Delhi, 2003.
4. Physical Chemistry – P. W. Atkins, Oxford University press, VIth edition, 1998.
5. Quantum Chemistry - W. Kauzmann, Academic press.
6. Theoretical Chemistry: An introduction to quantum mechanics, statistical mechanics, and molecular spectra for chemists - S. Glasstone, D. Van Nostrand Company, Inc., 1944.
7. Quantum Chemistry - R.K. Prasad, New Age International, New Delhi.
8. Physical Chemistry – R.S. Berry, S.A. Rice, J. Ross, 2nd Ed., Oxford University Press, New York, 2000.
9. Photochemistry – J. G. Calverts and J. N. Pitts, John-Wiley & Sons
10. Fundamentals of Photochemistry- K. K. Rohatgi-Mukharjii, Wiley Eastern
11. Introduction to Photochemistry-Wells 27
12. Photochemistry of solutions-C. A. Parker, Elsevier
13. An Introduction to Electrochemistry by S. Glasstone
14. Modern Electrochemistry Vol. I & II by J. O. M. Bockris and A.K.N. Reddy.
15. Electrolytic Solutions by R. A. Robinson and R. H. Strokes, 1959
16.Chemical Kinetics-K. J. Laidler, Pearson Education,2004
17. Kinetics and Mechanism - A. A. Frost and R. G. Pearson.
18. Electrochemistry- S. Glasstone, D. Van Nostrand , 1965
19. Advanced Physical Chemistry- Gurdeep Raj, Goel Publishing House
20.Basic chemical Kinetics- G. L. Agarwal, Tata-McGraw Hill
21. Physical Chemistry – G. M. Barrow, Tata-McGraw Hill, Vth edition, 2003.
22. The principles of physical Chemistry-PuriSharmaPatania5th Edition

Learning Outcomes

UNIT- I: Quantum Chemistry

1) Student should understand difference between Operators and related theorems
2) Student must explore applications of commutator,linear operators, uncertainty principle.
3) Understanding its interpretation.Normalization.
4) They should knewTransition dipole momentintegral and selection rules. Application to electronic spectra of conjugated linear organicmolecules.

5) They should Linear and angular momentum, eigen function and eigen values of angularmomentum operator, Ladder operator, addition of angular momenta.

UNIT-II: A] Photochemistry

1) Student shouldknowselection rules, photo-dissociation, pre-dissociation.
2) Student should know Electronic structure of molecules, molecular orbital, electronically excitedsinglet states, designation based on multiplicity rule.

B] Fluorescence

1)They should explain prompt fluorescence, delayed fluorescence, and phosphorescence,fluorescence quenching: concentration quenching, quenching byexcimer and exciplexemission

UNIT-III: Electrochemistry

1) Student must explain Debye - Huckel theory of inter-ionic attraction, ionic atmosphere, time of relaxation .
2) Student must state Debye-Huckel-Onsagar equation and its validity for dilute solutions and at appreciably concentrated solutions.
3) They should demonstrate Debye-Huckel-Bronsted equations. Quantitative and qualitative verification of Debye-Huckel limiting law, Bjerrum theory of ion-ion association.

UNIT-IV: Chemical Kinetics

1) Student must explain Experimental methods of following kinetics of a reaction, chemical and physical(measurement of pressure, volume, EMF, conductance, diffusion current and absorbance)methods.
2) Student must state Steady state approximation and study of reaction between NO_2andF2, decomposition of ozone, and nitrogen pentoxide.
3) They should demonstrate Heterogeneous catalysis: Adsorption of gas on as surface and its kinetics, Catalyzed hydrogen-deuterium exchange reaction
4) Student must explain Colloids and surfaces: Stability and properties of colloids; isotherms and surfacearea; heterogeneous catalysis.

Paper MCT-204: Analytical Chemistry

UNIT-I: A] Ultraviolet and visible spectrophotometry (UV-VIS) (08)

Introduction, Electronic transitions, Terms used in UV spectroscopy, Beer Lambert's law, types of recording spectra (solid, liquid), Solvent effect, Factors affecting on UV absorption band, calculation of absorption maxima of dienes, dienones and polyenes, applications.

B] Infrared Spectroscopy (IR) (07)

Introduction, instrumentation, Fundamental modes of vibrations, Fundamental group region, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications.

UNIT-II: A] Nuclear Magnetic Resonance (NMR): (08)

Introduction, Magnetic and non-magnetic nuclei, Elementary ideas of NMR Integration, Larmor frequency, absorption of radio frequency. Instrumentation (FT-NMR). Sample

preparation, chemical shift, Factor affecting chemical effect, spin-spin coupling, coupling constant,
First order coupling, applications to simple structural problems .

B] Mass spectroscopy (MS): (07)

Instrumentation, working of mass spectrometer (double beam). Formation of different types of ions, Mclaffertyrearrangements,Nitrogen rule, C-13 rule, fragmentation of alkanes, alkyl aromatics, alcohols and ketones, simple applications,simple structural problems based on IR, UV , NMR and MS

UNIT-III: Mossbauer and ESR Spectroscopy (15)

Introduction, Principle, spectral parameters and spectral display, application of studies of bonding structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate, spin and Sn^{+2} and Sn^{+4} compounds.
Introduction, ESR of d1 and d9transition metal ions in cubic and tetragonal ligand fields, evaluation of g values and metal hyperfine coupling constant.

UNIT-IV: A) Atomic Absorption and Flame Emission Spectroscopy (10)

Introduction, Principal, difference between AAS and FES, Advantages of AAS over FES, advantages and disadvantages of AAS.Instrumentation, Single and double beam AAS, detection limit and sensitivity, Interferences applications.

B) Inductively coupled Plasma Spectroscopy (5)

Introduction, Nebulisation Torch, Plasmsa, Instrumentation, Interferences, Applications.

References:

1. Carey and Sundberg. (Ed. III) , Part B – Adv. Organic Chemistry.
2. H.O. House , Synthetic Organic Chemistry.
3. Gould E.S., Mechanism and Structure in Organic Chemistry.
4. Norman R.O.C. Organic Chemistry.
5. J. March,(Ed IV), AdvOrganic Chemistry.
6. Silversteine and Basser, Spectrometric Identification of Organic Compounds.
7. Kalsi, Organic Spectroscopy.
8. J. Bellamy, Infrared spectra of Complex molecules.
9. I Fleming, Organic Spectroscopy.
10. J. Clayden, N.Greeveset. al Organic Chemistry
11. Eliel, Stereochemistry.
12. D. Nashipuri, Stereochemistry of Organic Compounds
13. Pavia Spectroscopy of Organic Compounds
14. Vogel Practical Organic Chemistry
15. Instrumental Methods of analysis- Willard, Merrit, Dean and Settle.
16. Spectroscopic methods in organic chemistry- D.H. Williams and I. Fleming
17. Absorption spectroscopy of organic molecules- V.M. Parikh
18. A Text book of Qualitative Inorganic Analysis- A. I. Vogel
19. Physical Methods in Inorganic Chemistry (DWAP)- R. Drago

20. Fundamentals of Analytical Chemistry – D.A. Skoog and D.M. West (Holt Rinehart and Winston Inc)

Learning Outcomes

UNIT-I: A] Ultraviolet and visible spectrophotometry (UV-VIS) and B] Infrared Spectroscopy (IR)

1) Student should understand Electronic transitions, Terms used in UV spectroscopy, Beer Lambert's law.
2) Student must explore conceptual fact of Solvent effect, Factors affecting on UV absorption band.
3) Student should understand Fundamental modes of vibrations, Fundamental group region, sampling technique, selection rules, types of bonds, absorption of common functional groups.

UNIT-II: A] Nuclear Magnetic Resonance (NMR) andB] Mass spectroscopy (MS)

1) Student should understand Fundamental modes of vibrations, Fundamental group region, sampling technique, selection rules, types of bonds, absorption of common functional groups.
2) Student should know Principle, working of mass spectrometer (double beam). Formation of different types of ions, Mclaffertyrearrangements, Nitrogen rule, C-13 rule, fragmentation.
3) Student must know the structural problems based on IR, UV , NMR and MS.

UNIT-III: Mossbauer and ESR Spectroscopy

1) Student must knowspectral parameters and spectral display.
2) Student must know bonding structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate.
3) Student should understand ESR of d1 and d9transition metal ions in cubic and tetragonal ligand fields.

UNIT-IV: A) Atomic Absorption Spectroscopy and B) Inductively coupled Plasma Spectroscopy

1) They must explain Principal, difference between AAS and FES.
2) They should explain Advantages of AAS over FES, advantages and disadvantages of AAS.
3) They should understand Nebulisation Torch, Plasmsa, Instrumentation.

Paper MCT-205 Applied Organic Chemistry

UNIT-I: Agrochemical (15)

a. Carbamate pesticides: Introduction and synthesis of carbaryl, carbofuran, Baygon, Aldicarb,Ziram, Zineb.

b. Organophosphorus pesticides: Malathion, monocrotophos, dimethoate, phorate, mevinphos,chloropyriphos.

c. Natural and synthetic pyrethroids: Isolation and structures of natural allethrin, fenvalerate,cypermethrin.

d. Plant growth regulators: General survey and synthesis of simple compounds and applications.
e. Insect repellents: General survey , synthesis and applications.
f. Juvenile harmone: introduction & structures JHA importance synthesis
g. Pheromones: introduction, examples, and importance in IPM. Synthesis of juvabione bombykol, grandisol and disparlure.

UNIT-II: A) Synthesis and applications of perfumery (5)

2-Phenylethanol, vanillin and other food flavours, synthetic musk and ionones.

B) Synthesis and applications of pharmaceuticals: **(5)**

Beridryl, Oxyphenbutazone&Ethambutol

C)Sugarbasedchemicals : Manufacture of furfural from bagasse, citric acid from molasses, acetic acid , butanealdehyde&butylacetate from ethanol. **(5)**

UNIT-III: Dyes and Intermediates (15)

Classification and synthesis of important dye intermediates by using nitration, sulphonation, diazotization reactions. Commercial processes for azo-dyes, reactive dyes, opticalbrighteners, thermal sensitive dyes, dispersed dyes and reactive dyes.

UNIT-IV: A) Polymers (10)

Mechanism of polymerization. Study of polyesters, polyamides, PVC, polystyrene,polyvinyl acetate and polyvinyl alcohol, polyethenes, viscose rayon, synthesis of polyethylene,polypropylene. Synthetic rubbers: Styrene-butadiene, butyl polyisoprene, phenol formaldehyderesin. Plasticizers and anti - oxidants for polymers, natural polymers: starch and cellulose.

B) Applications of Oxo and Wacker process; Soaps and Synthetic detergents **(5)**

References:

1. Allan: Colour Chemistry
2. K. Venkataraman: Chemistry of Synthetic Dyes Vol- 1 to 7
3. Abrahart: Dyes & their intermediates
4. N. N. Melikov: The Chemistry of Pesticides and formulations
5. K. H. Buchel: Chemistry of Pesticides.
6. R. Clemlyn: Pesticides
7. K. H. Buchel: Chemistry of Pesticides
8. H. R. Alcock and F. W. Lambe: Contemporary Polymer Chemistry
9. J. M. G. Cowie, Blackie: Physics & Chemistry of Polymers
10. P. H. Groggins: Unit Processes in Organic Synthesis
11. B. Biollot& P. V. Wells: Perfumary Technology
12. M. Ash & I. Ash: A formulary of Cosmetic Preparations

Learning outcomes

UNIT-I: Agrochemical

1) Student should understand organic reaction mechanism with respect to structure and reactivity.

2) Student must explore conceptual fact of Chemical bonding and basis of reactivity.
3) Understanding formation of atomic orbital through quantum approach.
4) They should knew energy level in atom using modern classical quantum mechanics.
5) They should understand behavior of electron in atom.

UNIT-II: A) Synthesis and applications of perfumery

1) Student should understand formation of various types of Aliphatic Nucleophilic substitutions.
2) Student should compare The SN2, SN1 and SNi reactions with respects to mechanism and stereochemistry.
3) Student should know Ambident nucleophiles, Neighbouring Group Participation.
4) Student must explain Aromatic Electrophilic Substitutions.
5) Student must state approach of the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in aromatic systems.
6) They should demonstrate concept of aromaticity, orientation inheir ring systems. Diazo-coupling, Vilsmeie reaction, Von Richter rearrangement.

UNIT-III: Dyes and Intermediates

1) They must explain the Addition to C-C multiple bonds - mechanism and stereochemical aspects of addition reaction.
2) They should explain nucleophile and free radicals, Regio and chemoselectivity,
3) They should understand Regio and chemoselectivity, orientation and reactivity, conjugate addition
4) Student must explain E1, E2 and E1cB mechanisms. Orientation in Elimination reactions
5) Student must state approach of the Hofman versus Saytzeff elimination, Pyrolyticsyn-elimination,
6) They should demonstrate concept of Pyrolytic elimination: Chugaev reaction, Cope reaction and Pyrolysis of acetates.

UNIT-IV: A) Polymers

1) Student should understand Symmetry operations: Rotation, reflection, inversion, rotation- reflection. Identification of the different axes and planes of symmetry.
2) Student should compare Principles of axial and planar chirality. Stereochemical features and configurational descriptors
3) Student should know Homotopic, heterotopic and diastereotopic ligands and faces.

Practical-III MCP-206- III

A) Inorganic Chemistry

1. Ore analysis – '1' ores (Dolomite, Galena)
2. Alloy analysis – '1' (Bronze, cupronickel)
3. Synthesis of nanomaterials of CuS/PbS/CdS/CuO/ZnO/TiO_2.

Reference:

1. A text book of Quantitative Inorganic Analysis – A. I. Vogel
2. Experimental Inorganic Chemistry - W. G. Palmer
3. The analysis of minerals and ores of the rarer elements – W. R. Schoeller and A.R. Powell, Charles, Griffin and Company Limited
4. I.M.Kolthoff, V.J.Elving and Sandell, "Treatise on Analytical Chemistry",Interscience.
5. I.M.Kothoff and Strenger, "Volumetric Analysis", Interscience
6. Fruman and Welcher, "Standard Methods of Inorganic Analysis", Van Nostrand
7. G.Schwarzenback, "Complexomtric Titrations", Interscience
8. D.A.Skoog and D.M.West, "Analytical Chemistry – An Introduction", Reinholdt.
9. R.S.Drago, "Physical Methods in Inorganic Chemistry", Affiliated East-West Press

Learning Outcomes

1) Student should understand the practical's of Inorganic Chemistry.
2) Student must explore different ore and alloy analysis of different metal compositions.
3) Student should understand synthesis of nanomaterials.

Practical- III MCP-206- III

B) Organic Chemistry

1. Qualitative analysis:

Separation and identification of the two component mixtures using Chemical and physical methods.

2.steam distillation techniques.

3.Estimation of pesticides

(Any other suitable experiments may be added).

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.Organic Synthesis Collective Volumes by Blat.

Learning Outcomes

1) Student should understand the qualitative analysis of organic chemistry.
2) Student should understand steam distillation techniques.
3)Student must explore to estimations of pesticides.

Practical -IV MCP-207-IV

A) Physical Chemistry

Students are expected to perform 15-20 experiments of three and half-hours duration. Experiments are to be set up in the following techniques.

1 Potentiometery:

i) Determination formal redox potential of system, determination of binary mixture of halides.

ii) Determination of stability Constant of a silver ammonium complex.

2. Conductometry :

Titration of ternary acid mixture of acids, Verification of Onsagar Equation for 1:1 type strong electrolyte.

3 Refractometry :

Determination of atomic refractions of H, C and Cl atoms.

4 Cryoscopy:

Determination of apparent weight and degree of dissociation a strong electrolyte equilibrium methods.

5 Chemical kinetics:

Kinetics of iodination of acetone in presence of strong acid etc.

6 Phase Equilibrium:

Three component system etc.

7 Viscometry

Determination of glycerol radius by viscosity

(New experiments may be also be added)

References:

1. Findlay's Practical Chemistry – Revised by J.A. Kitchner (Vedition)
2. Text Book of Quantitative inorganic analysis : A.I. Vogel.
3. Experimental Physical Chemistry : By F. Daniels and J. Williams
4. Experimental Physical Chemistry : R.C Das and B.Behera
5 Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan

Learning Outcomes

1) Student should understand the practical's of physical chemistry.
2) Student must explore variety of instrumental experiments.
3) Student should understand physical properties through these experiments.

Practical –IV MCP-207- IV

B) Analytical Chemistry

Physical Chemistry Section:

1 To determine formula of complex ion by Job's method by colorimetry.

2 Determine the solubility of lead iodide in presence of varying concentration of Salt KCl.

3 Determine the solubility of lead iodide in presence of varying concentration of Salt KNO_3

Organic Chemistry Section

1 Analysis of pharmaceutical tablets: Ibrufen / INAH

2 Colorimetric estimation of drugs/dyes

3 Preparation of pesticides.

4 Column and thin layer chromatography

Inorganic Chemistry Section

1 To determine the amount of copper in brass metal alloy colorimetrically.

2 Separation and estimation of Copper and Cobalt on cellulose Column.

3 Separation and estimation of Nickel and Cobalt on a anion exchanger.

4 Separation and estimation of Iron and aluminium on a cation exchanger.

References:

1 A Text book of quantitative Inorganic Analysis – A.I.Vogel

2 Standards methods of Chemical Analysis-F.J. Welcher.

3 Experimental Inorganic Chemistry – W.G.Palmer.

4 Manual on Water and Waste Water Analysis, NEERI- Nagpur D.S. Ramteke and C.A.Moghe

5 Inorganic synthesis- King.

6 Synthetic Inorganic Chemistry-W.L.Jolly

7 EDTA Titrations –F.Laschka

Learning Outcomes

1) Student should understand the number of practicals like determine formula of complex ion by Job's method by colorimeter, Separation and estimation of Nickel and Cobalt on a anion exchanger, Preparation of pesticides.
2) Student must explore different concepts of practicals which is industrially important.
3) Student should understand applications of experimental chemistry.