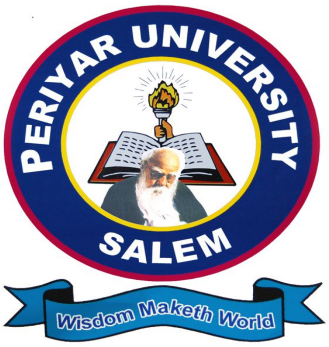
PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636 011



DEGREE OF MASTER OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR BRANCH IV M.SC. CHEMISTRY

FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2017 – 2018 ONWARDS

M.Sc. Chemistry Course Structure under CBCS										
(For the candidates admitted from the academic year 2017-2018 onwards)										
Semester	Paper Code	Course	Course Title	Hours / Week	Work Load per Semester (Hours)	Credit	Exam	Marks		Total
							Hours	Internal	External	
I		Core Paper - I	Organic Chemistry - I	5	75	5	3	25	75	100
		Core Paper - II	Inorganic Chemistry -I	5	75	5	3	25	75	100
		Core Paper - III	Physical Chemistry - I	5	75	5	3	25	75	100
		Elective Paper - I	Polymer Chemistry/Conducting Polymers	5	75	4	3	25	75	100
		Core Practical - I	Organic Chemistry Practical -I	4	60	-	-	-	-	-
		Core Practical - II	Inorganic Chemistry Practical -I	3	45	-	-	-	-	-
		Core Practical - III	Physical Chemistry Practical - I	3	45	-	-	-	-	-
			Total	30	450	19				400
II		Core Paper - IV	Organic Chemistry - II	5	75	5	3	25	75	100
		Core Paper - V	Physical Chemistry -II	5	75	5	3	25	75	100
		Elective Paper - II	Spectroscopy	5	75	4	3	25	75	100
		EDC	Extra Disciplinary course	4	60	4	3	25	75	100
		Core Practical - I	Organic Chemistry Practical -I	3	45	3	6	40	60	100
		Core Practical - II	Inorganic Chemistry Practical -I	3	45	3	6	40	60	100
		Core Practical - III	Physical Chemistry Practical - I	3	45	3	6	40	60	100
			Human Rights	2	30	2	3	25	75	100
			Total	30	450	29				800
III		Core Paper - VI	Organic Chemistry - III	5	75	5	3	25	75	100
		Core Paper - VII	Inorganic Chemistry - II	5	75	5	3	25	75	100
		Core Paper - VIII	Physical Chemistry - III	5	75	5	3	25	75	100
		Elective Paper - III	Experimental methods in Chemistry/Electroanalytical Techniques	5	75	4	3	25	75	100
		Core Practical - IV	Organic Chemistry Practical - II	3	60	-	-	-	-	-
		Core Practical - V	Inorganic Chemistry Practical - II	4	45	-	-	-	-	-
		Core Practical - VI	Physical Chemistry Practical - II	3	45	-	-	-	-	-
			Total	30	450	19				400
IV		Core Paper - IX	Inorganic Chemistry - III	5	75	5	3	25	75	100
		Elective Paper - IV	Green and Nano Chemistry/Medicinal Chemistry	5	75	4	3	25	75	100
		Core Practical - IV	Organic Chemistry Practical - II	3	45	3	6	40	60	100
		Core Practical - V	Inorganic Chemistry Practical - II	3	45	3	6	40	60	100
		Core Practical - VI	Physical Chemistry Practical - II	3	45	3	6	40	60	100
		Project	Dissertation/Project work	11	165	7	-	-	-	200
			Total	30	450	25				700
			Grand Total	120	1800	92				2300

The students can choose the Elective Paper from the choice given.

Note: I

Core Papers	: 9
Core Practicals	: 6
Elective papers	: 4
EDC	: 1
Human Rights	: 1
Project	: 1

Note : II

Distribution of Marks

Theory

University Examination (External)	: 75 marks
Internal Assessment	: 25 marks

Distribution of Internal Assessment mark

Test	: 10 marks
Attendance	: 5 marks
Assignment	: 5 marks
Seminar	: 5 marks
Total	**25 marks**

Passing Minimum : Internal Assessment : 50%	-12 marks
Passing Minimum : External Assessment : 50%	-38 marks
Total Passing Minimum	**-50 marks**

Practicals

University Examination (External)	: 60 marks
Internal Assessment	: 40 marks

Calculation of Internal Assessment mark

Number of Experiments	: 10 marks
Experimental skill	: 10 marks
Test	: 20 marks
Total	**: 40 marks**

Passing Minimum : Internal Assessment : 50%	-20 marks
Passing Minimum : External Assessment : 50%	-30 marks
Total Passing Minimum	**-50 marks**

Everything should be supported by proper record
separate passing minimum is necessary for Internal and External

Question paper pattern
Theory

Time: 3 Hours **Max. marks : 75**

Part - A : 5X5 = 25
(Answer all questions)
(one question from each unit with internal choice)

Part - B : 5X10 = 50
(Answer all questions)
(one question from each unit with internal choice)

Practical

Distribution of marks for practical

Experiment	: 45 marks
Viva-voce in practical	: 10 marks
Record	: 5 marks
Total	: 60 marks
Duration	: 6 Hours

Project

Dissertation / Project	: 150 marks
Viva - voce	: 50 marks
Total	: 200 marks

SYLLABUS FOR BRANCH IV M.Sc. CHEMISTRY
FIRST SEMESTER
Core Paper - I
ORGANIC CHEMISTRY – I
(75 Hours)

OBJECTIVES

- To learn about the stereochemistry of organic compounds
- To learn about the formation, stability and structure of intermediates and the effect of structure on reactivity.
- To learn about the mechanism of aliphatic and aromatic nucleophilic substitution reactions and aromatic electrophilic substitution reactions.
- To learn about the structural elucidation of alkaloids flavones and isoflavones.

UNIT – I Stereochemistry (15 Hours)

Fischer, Newman and Sawhorse projections and their interconversion. Axial chirality – biphenyls, allenes and spiranes – R and S notations. Chirality due to helical shape, planar chirality - Cyclophanes, ansa compounds and trans cyclooctene. Stereospecific and stereoselective synthesis with suitable examples, asymmetric synthesis – Crams rule. Homotopic, enantiotopic, diastereotopic H atoms, groups in organic molecules.

Conformational analysis and stereochemical features of disubstituted cyclohexanes (1,2 ; 1,3 ; 1,4 dialkyl cyclo hexanes), conformation and stereochemistry of cis and trans decalins.

UNIT – II Reaction intermediates, Structure and Reactivity (15 Hours)

Reaction intermediates : Formation, stability and structure of carbonium ions, carbanions, carbenes, nitrenes and free radicals.

Free radical reactions : Sandmeyer reaction, Gomberg-Bachmann reaction, Pschorr reaction and Ullmann reaction, Hunsdiecker reaction.

Effect of structure on reactivity – resonance and fields effects, steric effects, quantitative treatment – the Hammett equation and linear free energy relationship, substituent and reaction constant, Taft equation. Thermodynamic and kinetic requirements for reactions, thermodynamically and kinetically controlled reactions, Hammonds postulate, transition states and intermediates, Kinetic & non kinetic methods of determining mechanisms, identification of products and determination of the presence of an intermediate, isotopic labeling, kinetic isotope effects.

UNIT – III Aliphatic Nucleophilic Substitution Reactions (15 Hours)

The SN1, SN2 & SNi mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon.

Reactivity effects of substrates structure, attacking nucleophile, leaving group and reaction medium, ambident nucleophile, regioselectivity. Williamson reaction, Von-braun reaction, hydrolysis of esters, Claisen and Dieckmann condensation.

UNIT IV Aromatic electrophilic and nucleophilic substitution reactions (15 Hours)

The arenium ion mechanism, typical reactions like nitration, sulphonation, halogenation, Friedel – Crafts alkylation, acylation and diazonium coupling, electrophilic substitution on monosubstituted benzene, orientation and reactivity – ortho, meta and para directing groups, ortho-para ratio, ipso attack, Gatterman, Gatterman- Koch, Vilsmeir, Houben Hoesch reaction.

Aromatic nucleophilic substitution reactions, the S_NAr mechanism, the aryl cation mechanism, the benzyne intermediate mechanism, Ziegler alkylation, Chichibabin reaction.

UNIT – V Alkaloids, Flavones and Isoflavones (15 Hours)

Synthesis and Structural elucidation of Quinine, Papaverine, Morphine and Reserpine.

Synthesis and structural elucidation of flavones, isoflavones and anthocyanins.

Text Books

1. Jerry March, Advanced Organic Chemistry-Reactions, Mechanisms and Structure, Fourth Edition, John Wiley & Sons (1992)
2. Francis A. Carey, Organic Chemistry, Third Edition, The McGraw-Hill Companies, Inc., 1996.
3. P.S. Kalsi, Organic Reactions and Mechanisms, Second Edition, New Age International Publishers, 2002.
4. Ernest L. Eliel, Stereochemistry of Carbon Compounds, T.M.H Edition, Tata McGraw-Hill Publishing Company, 1995.
5. P.S. Kalsi, Stereochemistry – Conformation and Mechanism, 6th Edition, Wiley Eastern Limited, 2005.
6. I.L. Finar, Organic Chemistry, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)

Reference Books

1. P.S. Kalsi, Stereochemistry and Mechanism through solved problems, Second Edition, New Age International Publishers, 1994.
2. D. Nasipuri, Stereochemistry of Organic Compounds, 2nd Edition, New Age International Publishers, 1994.
3. S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, 1st Edition, Macmillan, 1976.
4. R.T. Morrison and R.N. Boyd, Organic Chemistry, 6th Edition, Prentice-Hall, 1992.
5. R.O.C. Norman, Principles of Organic Synthesis, Second Edition, Chapman and Hall, 1978.

Core Paper- II
INORGANIC CHEMISTRY-I

Objectives:

i) To learnt about the various theories of complexes, mode of coordination with various geometry.

ii) To study the recent development in polymeric materials of coordination complexes.

UNIT-I Structure and Bonding (15 Hours)

Hard and Soft acids and bases-classifications, Acid-Base strength, hardness, symbiosis, Theoretical basis of Hardness and Softness, applications of HSAB.

Rings-Phosphazenes-Structure, Craig and Peddock model, Dewar model, polyorganophosphazenes, Polysulphur –nitrogen compounds.

Inorganic polymers-Silicates-structure, Pauling's rule, properties, correlation and application; Molecular sleves.

Polyacids- Isopolyacids of V, Cr, Mo and W; Heteropolyacids of Mo and W (only structural aspects).

UNIT – II Metal - Ligand Bonding (15 Hours)

Crystal field theory – splitting of d- orbitals under various geometries, factors affecting splitting, CFSE, evidences for CFSE (Structural and thermodynamic effects), Spectrochemical series, Jorgensen relation, site preferences; Jahn – Teller distortion – Splitting pattern in trigonal pyramid, square pyramidal and cubic symmetries, Dynamic and Static J.T. effect, Jahn – Teller effect and Chelation; Limitations of CFT; Evidences for metal – ligand overlap; M.O. theory and energy level diagrams, concept of weak and strong fields, sigma and pi bonding in complexes, nephelauxetic effect, magnetic properties of complexes.

UNIT – III Electronic Spectroscopy of transition metals and Inorganic Photochemistry (15 Hours)

Spectroscopic Term symbols for dn ions – derivation of term symbols and ground state term symbol, Hund's rule; Selection rules – break down of selection rules, spin-orbit coupling, band intensities, weak and strong field limits- correlation diagram; Energy level diagrams; Orgel and Tanabe – Sugano diagrams; effect of distortion and spin orbit coupling on spectra; Evaluation of Dq and B values for octahedral complexes of Nickel; Charge transfer spectra. Spectral properties of Lanthanides and Actinides.

Inorganic photochemistry-Photosubstitution, Photoredox and isomerisation processes; application of metal complexes in solar energy conversion.

UNIT – IV Inorganic Reaction mechanism (15 Hours)

Electron transfer reactions – Outer and inner sphere processes; atom transfer reaction, formation and rearrangement of precursor complexes, the bridging ligand, successor complexes; Cross reactions and Marcus – Hush theory (no derivation)

Reaction mechanism of coordination compounds – Substitution reactions, Labile and inert complexes. Substitution in square planar complexes – General mechanism; reactivity of Platinum complexes; influences of entering and leaving groups; the trans effect – theories, trans influence.

Substitution in octahedral complexes – general mechanism, discussion of A, D, IA, ID and DCB mechanism, replacement of coordinated water; mechanism of acid hydrolysis and base hydrolysis – Conjugate base mechanism; direct and indirect evidences in favour of the mechanism; application of substitution reaction in the synthesis of Platinum and Cobalt complexes.

UNIT – V Boron compounds and Clusters (15 Hours)

Boron hydrides – polyhedral boranes, hydroborate ions – a general study of preparation, properties and structure, styx numbers, Wade's rules.

Carboranes – types such as closo and nido – preparation, properties and structure. Metallo carboranes – a general study.

Metal clusters – Chemistry of low molecularity metal clusters only – structure of Re2Cl8; multiple metal – metal bonds.

Text Books:

1. J.E.Huheey, E.A.Keiter and R.L.Keiter, Inorganic chemistry-principles of structure and reactivity, 4th edition, Pearson-Education, 2002
2. F.A.Cotton and G.Wilkinson, Advanced Inorganic Chemistry, Wiley Eastern, 5th edition, 1988.
3. E.A.V.Ebsworth, D.WH.Rankine and S.Craddock, Structural methods in Inorganic Chemistry, Black well Scientific publication, 1987

Reference Books:

1. A.W.Adamson and P.Fleischauer, Concepts of Inorganic Photochemistry, Wiley, 1975.
2. H.J.Emelius and Sharpe, Modern aspects of Inorganic chemistry, Universal book stall, New Delhi, 1989
3. F. Basolo and R.G. Pearson, Mechanism of Inorganic Reactions, Wiley Eastern, 1967.
4. S.F.A. Kettle, Coordination compounds, ELBS, 1973.
5. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, WB. Sanders Co. USA. 1977.
6. D.F. Shriver, P. W. Atkins and C.H. Longford, Inorganic Chemistry, ELBS, 2nd Edition, 1994.
7. R.B. Heslop and K. Jones, Inorganic Chemistry, Elsevier, 1976.

Core Paper - III
PHYSICAL CHEMISTRY – I [75 Hours]

OBJECTIVES

- To study in detail the basic concepts of classical thermodynamics and chemical kinetics
- To understand the principles of quantum chemistry and group theory

Unit – I Classical Thermodynamics – I (15 Hours)

Maxwell's relations and thermodynamic equations of state – applications in the evaluation of Cp – Cv for solids and for van derwaals gases, Cp – Cv in terms of coefficient of expansion and coefficient of compressibility – Partial molar properties — Partial molar free energy - Gibbs – Duhem equation (Chemical Potential) – Determination of chemical potential [Direct Method and Method of Intercepts]– variation of chemical potential with temperature and pressure- partial molar volume.

UNIT – II Classical Thermodynamics – II (15 Hours)

Thermodynamics of ideal and real gases– Fugacity –Methods of determination of fugacity – Variation of fugacity with temperature and pressure. Standard states for gases, liquids, solids and components of solutions. Solution of electrolytes – Concept of ionic strength-.mean ionic activity and mean ionic activity coefficient – determination of activity coefficient from freezing point, EMF and solubility measurements.

Unit –III Chemical Kinetics – I (15 Hours)

Theories of reaction rates – Arrhenius theory, Hard sphere collision theory and transition state theory of reaction rates– Comparison of collision theory and activated complex theory – Lindemann and Hinshelwood theories of unimolecular reaction rates. Reactions in solutions – comparison between gas phase and solution reactions – influence of solvent, ionic strength, and pressure on reactions in solution – Kinetic isotope effects .

Unit – IV Quantum Chemistry – I (15 Hours)

Planck's theory of black body radiation – Photoelectric effect; de – Broglie equation – Heisenberg uncertainty principle – Compton effect; operators and commutation relations – quantum mechanical postulates – Schrodinger equation and its solution to the problem of a particle in one and three dimensional boxes – the harmonic oscillator.

Unit – V Group Theory – I (15 Hours)

Symmetry elements and symmetry operations – Point groups – identification and representation of groups – comparison of molecular and crystallographic symmetry – Reducible and irreducible representation – Direct product representation – Great orthogonality theorem and its consequences – Character table and its uses.

Reference Books:

1. W.J. Moore, Physical Chemistry, Orient Longman, London, 1972.
2. K.G. Den beigh, Thermodynamics of Steady state, Meklien and Co., London, 1951.
3. L.K. Nash, Elements of Chemical Thermodynamics, Addison Wesley, 1962.
4. R.G.Frost and Pearson, Kinetics and Mechanism, Wiley, Newyork, 1961.
5. J.W. Moore and R.G. Pearson, Kinetics and Mechanism, 1981.
6. C.Capellos and B.H.J. Bielski, Kinetic systems, Willey interscience, Newyork, 1968
7. G.M.Harris, Chemical Kinetics, D.C. Heath and Co., 1966.
8. A.K. Chandra, Introductory Quantum Chemistry, Tata Mc Graw Hill.
9. D.A. Mc Quarrie, Quantum Chemistry, University science books, Mill Valley, California (1983).
10. P.W.Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford., 1983
11. I.N.Levine, Quantum chemistry, Allyn and Bacon, Boston, 1983.
12. F.J.Bockhoff, Elements of Quantum theory, Addision Wesley, Reading, Mass, 1976.
13. H.Eyring, J.Walter and G. Kimball, Quantum chemistry, John wiley and sons, Newyork, 1944.
14. L.S.Pauling and E.B.Wilsob, Introduction to Quantum Mechanics, Mc Graw Hill book Co., Newyork, 1935.
15. F.A. Cotton, Chemical Application of Group Theory, John Wiley and Sons Inc., Newyork, 1971.
16. N. Tinkham, Group Theory and Quantum Mechanics, McGraw Hill Book Company, Newyork, 1964.
17. Alan Vincent, Molecular Symmetry and Group theory – Programmed Introduction to chemical applications, Wiley, Newyork, 1977.

Text Books:

1. S.Glasstone, Thermodynamics for chemists, Affiliated East West press, New Delhi, 1960.
2. J. Rajaram and J.C. Kuriacose, Thermodynamics for students of chemistry, Lal Nagin Chand, New Delhi, 1986.
3. J. Rajaram and J.C. Kuriacose, Kinetics and mechanism of chemical transformation, Macmillan India Ltd., 1993.
4. K.J.Laidler, Chemical Kinetics, Harper and Row, Newyork, 1987.
5. R.K. Prasad, Quantum Chemistry, Wiley Eastern, New Delhi, 1992.
6. M.W. Hanna, Quantum mechanics in chemistry, W.A. Benjamin INC, London (1965)
7. V.Ramakrishnan and M.S.Gopinathan, Group theory in chemistry, Vishal Publications, 1988.
8. K.V.Raman, Group theory and its application to chemistry, Tata McGraw Hill Publishing Co., 1990.
9. Gurudeep raj, Advanced Physical Chemistry, Goel Publishing House, Meerut.

Elective Paper - IA
POLYMER CHEMISTRY
(75 Hours)

OBJECTIVES

- To study the basic concepts in polymer chemistry.
- To learn about the kinetics and types of co-ordination polymerization.
- To study the measurement of molecular weight and the properties of polymers.
- To study about the polymer processing and properties of commercial polymers.

UNIT – I Basic Concepts (15Hours)

Monomers, repeat units, degree of polymerization, Linear, branched and network Polymers. Condensation Polymerization : Mechanism of stepwise polymerization. Kinetics and statistics of linear stepwise polymerization. Addition polymerization : Free radical, cationic and anionic polymerization. Polymerization conditions. Polymerization in homogeneous and heterogeneous systems.

UNIT – II Co-ordination Polymerization (15 Hours)

Kinetics, mono and bimetallic mechanism of co-ordination polymers. Zeigler Natta catalyst, co-polymerization: Block and graft co-polymers, kinetics of copolymerization. Types of co-polymerization. Reactivity ratio.

UNIT – III Molecular Weight and Properties (15 Hours)

Polydispersion – average molecular weight concept, number, weight and viscosity average molecular weights. Measurement of molecular weights. Viscosity, light scattering, osmotic and ultracentrifugation methods. Polymer structure and physical properties – crystalline melting point T_m. The glass transition temperature. Determination of T_g. Relationship between T_m and T_g.

UNIT – IV Polymer Processing (15 Hours)

Plastics, elastomers and fibres. Compounding, processing techniques: calendering, die casting, rotational casting, film casting, injection moulding, blow moulding extrusion, moulding, thermoforming, foaming, reinforcing and fibre spinning.

UNIT – V Properties of Commercial Polymers (15 Hours)

Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers, Fire retarding polymers and electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Text Books

1. F.W. Billmeyer, TextBook of Polymer Science, 3rd Edition, J.Wiley, 2003.
2. V. R. Gowariker, N.V. Viswanathan and J. Sreedhar, Polymer Science, New Age Int., 1986.

Reference Books

1. H.R. Alcock and F.W. Lamber, Contemporary Polymer Chemistry, Prentice Hall, 1981.
2. P.J. Flory, Principles of Polymer Chemistry, Cornell University press, New York, 1953.
3. G. Odian, Principles of Polymerization, 2nd Edition, John Wiley & Sons, New York, 1981.

Elective Paper - IB
CONDUCTING POLYMERS

OBJECTIVES

- To study the basic concepts and synthetic methods.
- To learn about the Electrochemical Synthesis.
- To study about the Semiconducting and Metallic Polymers.
- To study about Doping.
- To learn about the Catalytic Conducting Polymers.

UNIT – I Basic Concepts and Synthetic methods

Basics of conducting polymers - Organic - conjugated unsaturated hydrocarbons- Chemical Synthesis of conducting polymers – Other synthetic methods

UNIT – II Electrochemical Synthesis

Electrochemical synthesis of conducting polymers – monomers, electrolytic condition, electrodes and mechanism; Electrochemical synthesis of derivatives of poly pyrrole, polythiophene, polyazulene, polycarbazole, polyindole, polyaniline and polyphenylene.

UNIT – III Semiconducting and Metallic Polymers

Structural basis for semiconducting and metallic polymers – introduction; Organic meta polymers - Synthetic route, isomers and electronic structure (polymers like polyacetylene, poly(p-phenylene), polypyrrole, polythiophene, etc.,).

UNIT – IV Doping

Electrochemical doping; deadline to the development of conducting polymers; role of reduction and oxidation potential in doping; polyacetylene as electrode materials.

UNIT – V Catalytic Conducting Polymers

Catalytic properties of conducting polymers; catalysis of electron donor-acceptor complexes; electrocatalysis by semiconducting polymers.

Text Books

1) Terje A. Skotheim, Ronald L. Elsenbaumer, John R. Reynolds, Handbook of Conducting Polymers, Second Edition, Marcel Dekkar, 1995.

2) Hari Singh Nalwa (Edn), Handbook of Organic Conductive Molecules and Polymers, Four Volumes, Wiley, 1997

Reference Books

1) Jean-Pierre Farges, Organic Conductors, Marcel Dekkar, 1994
2) David B Cotts, Z Reyes, Electrically Conductive Organic Polymers for Advanced Applications, William Andrew Inc,1987
3) Larry Rupprecht, Conductive Polymers and Plastics, William Andrew Inc, 1999.
4) Raymond B Seymour, New Concepts in Polymer Science, Polymeric Composites, VSP, 1990.
5) Wallace Gordon, Gordon G Wallace, Geoffrey M Spinks, Conductive Electroactive Polymers, CRC Press, 2002

SECOND SEMESTER
Core Paper - IV
ORGANIC CHEMISTRY – II
[75 Hours]

OBJECTIVES

- To learn the mechanism of Elimination reactions.
- To understand the basic concepts of aromaticity.
- To know the effects of light in organic reactions.
- To study the pericyclic reactions.
- To learn the uses of oxidation and reducing reagents in organic synthesis.

UNIT – I Elimination Reactions (15 Hours)

E1, E2, E1cB mechanisms, Orientation of the double bond- Hofmann and Saytzeff rule, competition between elimination and substitution, dehydration and dehydrohalogenation reactions, stereochemistry of E2 eliminations in cyclohexane ring systems, mechanism of pyrolytic eliminations, chugaev reaction and Cope elimination.

UNIT - II Aromaticity (15 Hours)

Aromatic character: Five-, six-, seven-, and eight-membered rings - other systems with aromatic sextets - Huckel's theory of aromaticity, concept of homoaromaticity and antiaromaticity.

Electron occupancy in MO's and aromaticity - NMR concept of aromaticity and antiaromaticity, systems with 2,4,8 and 10 electrons, systems of more than 10 electrons (annulenes), Mobius aromaticity.

Bonding properties of systems with $(4n+2)\pi$-electrons and $4n\pi$ - electrons, alternant and non-alternant hydrocarbons (azulene type) - aromaticity in heteroaromatic molecules, sydnones and fullerenes.

UNIT – III Organic Photochemistry (15 Hours)

Photochemical reactions : Fate of excited molecules, Jablonski diagram, Norrish Type I and Norrish Type II reactions, photoreduction of ketone, photoaddition reactions, Paterno Buchi reaction, di –pi methane rearrangement, photochemistry of arenes, Photooxidation (Formation of peroxy compounds), Photoisomerization (Cis – trans isomerization), Photo addition of olefins and amines to aromatic compounds, Photo rearrangements: Photo – Fries rearrangement and Photo rearrangement of 2,5 – Cyclohexadienones.

UNIT – IV Pericyclic Reactions (15 Hours)

Pericyclic reactions, classification, orbital symmetry, Woodward Hofmann rules, selection rules and stereochemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts, analysis by correlaton diagram method and Frontier molecular orbital method, Sommelet - Hauser, Cope and Claisen rearrangements.

UNIT – V Reagents in Organic Synthesis (15 Hours)

Reagents and their uses: DCC, DDQ, DBU, DIBAL, 9BBN, NBS, 1,3 – dithiane (umpolung), n-Butyl Lithium, trimethyl silyl iodide, trimethyl silyl chloride, Lithium dimethyl cuprate, Baker's yeast and Gilman's reagent.

Text Books

1. Jerry March, Advanced Organic Chemistry-Reactions, Mechanisms and Structure, Fourth Edition, John Wiley & Sons (1992)
2. Francis A. Carey, Organic Chemistry, Third Edition, The McGraw-Hill Companies, Inc., 1996.
3. P.S. Kalsi, Organic Reactions and Mechanisms, Second Edition, New Age International Publishers, 2002.
4. Charles H.Depuy, molecular reactions and photochemistry, Orville L.Chapman. Prentice Hall of India Pvt Ltd. New Delhi 1988.
5. I.L. Finar, Organic Chemistry, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)

Reference Books

1. S. H. Pine, J.B. Hendrickson, D.J. Cram and G.S. Hammond, Organic Chemistry, IV Edn., McGraw Hill Company, 1980.
2. S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, 1st Edition, Macmillan, 1976.
3. R.T. Morrison and R.N. Boyd, Organic Chemistry, Prentice-Hall, 1992.
4. R.O.C. Norman, Principles of Organic Synthesis, Second Edition, Chapman and Hall, 1978.
5. S.M. Mukherji and S.P. Singh, Reaction Mechanism in Organic Chemistry, III Edn. 1984. MacMillan.

Core Paper - V
PHYSICAL CHEMISTRY – II [75 Hours]

OBJECTIVES

- To study in detail the basic concepts of statistical thermodynamics and chemical kinetics
- To understand the principles of quantum chemistry and group theory
- To impart knowledge on surface chemistry and catalysis

UNIT – I Statistical and Irreversible Thermodynamics (15 Hours)

Concept of thermodynamical and mathematical probabilities – Distribution of distinguishable and non – distinguishable particles. Maxwell –Boltzmann, Bose-Einstein and Fermi-Dirac statistics - comparisions Partition functions – rotational, vibrational, translational and electronic partition functions- Expression of equilibrium constant in terms of partition function – Einstein and Debye theory of heat capacities of solids.
Non equilibrium thermodynamics- Entropy production in heat flow and matter flow – Progogine's principle of minimum entropy production – Forces and fluxes – microscopic reversibility and Onsager's reciprocal relations.

UNIT – II Chemical Kinetics – II (15 Hours

Kinetics of complex reactions – reversible reactions, consecutive reactions – Parallel reactions and Chain reactions –Rice Herzfeld mechanism – explosion limits. Study of fast reactions: Relaxation methods-temperature and pressure jump methods - Stopped flow technique, flash photolysis and Crossed molecular beam method.

UNIT – III Surface Chemistry and Catalysis (15 Hours)

Adsorption-Physical and chemical adsorption – adsorption isotherms – Langmuir, Freundlich and B.E.T adsorption isotherms – measurement of surface area from BET;
Catalysis-:acid – base catalysis–heterogeneous catalytsis- Enzyme catalysis – effect of substrate concentration- Michaelis – Menton equation-effect of pH and temperature.

UNIT – IV Quantum Chemistry –II (15 Hours)

Application of Schrödinger equation to rigid rotator and hydrogen atom –origin of quantum numbers – probability distribution of electrons. Approximation methods – Perturbation and Variation methods – Slater determinant -application to hydrogen and helium atom — Spin - orbit interaction – LS coupling and JJ coupling – ground state term symbols for simple atoms.

UNIT – V Group Theory – II (15 Hours)

Symmetry selection rules for vibrational, Electronic and Raman Spectra – determination of vibrational modes in non-linear molecules such as H_2O, NH_3, CH_4 , XeF_4, – symmetry of

hybrid orbitals in non-linear molecules (H_2O, NH_3, CH_4, XeF_4, PCl_5) – Electronic spectra of formaldehyde.

Reference Books:

1. W.J. Moore, Physical Chemistry, Orient Longman, London, 1972.
2. K.G. Den beigh, Thermodynamics of Steady state, Meklien and Co., London, 1951.
3. L.K. Nash, Elements of Chemical Thermodynamics, Addison Wesley, 1962.
4. R.G.Frost and Pearson, Kinetics and Mechanism, Wiley, Newyork, 1961.
5. J.W. Moore and R.G. Pearson, Kinetics and Mechanism, 1981.
6. C.Capellos and B.H.J. Bielski, Kinetic systems, Willey interscience, Newyork, 1968
7. G.M.Harris, Chemical Kinetics, D.C. Heath and Co., 1966.
8. A.K. Chandra, Introductory Quantum Chemistry, Tata Mc Graw Hill.
9. D.A. Mc Quarrie, Quantum Chemistry, University science books, Mill Valley, California (1983).
10. P.W.Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford., 1983
11. I.N.Levine, Quantum chemistry, Allyn and Bacon, Boston, 1983.
12. F.J.Bockhoff, Elements of Quantum theory, Addision Wesley, Reading, Mass, 1976.
13. H.Eyring, J.Walter and G. Kimball, Quantum chemistry, John wiley and sons, Newyork, 1944.
14. L.S.Pauling and E.B.Wilsob, Introduction to Quantum Mechanics, Mc Graw Hill book Co., Newyork, 1935.
15. F.A. Cotton, Chemical Application of Group Theory, John wiley and Sons Inc., Newyork, 1971.
16. N. Tinkham, Group Theory and Quantum Mechanics, McGraw Hill Book Company, Newyork, 1964. 17. Alan Vincent, Molecular Symmetry and Group theory – Programmed Introduction to chemical applications, Wiley, Newyork, 1977.

Text Books:

1. S.Glasstone, Thermodynamics for chemists, Affiliated East West press, New Delhi, 1960.
2. J. Rajaram and J.C. Kuriacose, Thermodynamics for students of chemistry, Lal Nagin Chand, New Delhi, 1986.
3. J. Rajaram and J.C. Kuriacose, Kinetics and mechanism of chemical transformation, Macmillan India Ltd., 1993.
4. K.J.Laidlar, Chemical Kinetics, Harper and Row, Newyork, 1987.
5. R.K. Prasad, Quantum Chemistry, Wiley Eastern, New Delhi, 1992.
6. M.W. Hanna, Quantum mechanics in chemistry, W.A. Benjamin INC, London (1965)
7. V.Ramakrishnan and M.S.Gopinathan, Group theory in chemistry, Vishal Publications, 1988.
8. K.V.Raman, Group theory and its application to chemistry, Tata McGraw Hill Publishing Co., 1990.
9. Gurudeep raj, Advanced Physical Chemistry, Goel Publishing House, Meerut.

ELECTIVE PAPER - II
SPECTROSCOPY
(75 hours)

OBJECTIVES

- To understand the basic concepts of spectroscopic techniques and to solve the structures from the spectra
- To study in detail about UV-VIS, IR, ESR, PAS and NMR spectroscopic techniques
- To develop problem solving skills from various type of spectra

UNIT – I UV-VIS AND IR SPECTROSCOPY (15 Hours)

UV-VIS: The nature of the electronic excitations, origin of UV band structure and the principle of absorption, chromophores and auxochromes, factors affecting intensity-solvent effects and position of absorption bands- dienes, polyenes and enones-Woodward-Fieser rules for dienes, enones and aromatics-calculation of λ_{max} for organic molecules-applications of UV spectroscopy.

IR : IR absorption process, modes of stretching and bending vibrations, bond properties and their relations to absorption frequencies, Characteristic group frequencies of aliphatic and aromatic organic molecules, carbonyl, carboxylic acid, ester, alcohol, phenol and amides. Factors influencing vibrational frequencies, interpretation of IR spectra of organic molecules- applications of IR spectroscopy.

UNIT – II NMR SPECTRSCOPY – I (15 Hours)

^{1}H NMR- principle - Shielding and deshielding - chemical shift, factors influencing chemical shift – magnetic anisotropy- Spin – spin splitting- (n+1rule), Coupling constant – Pascal's triangle, calculation of coupling constants, mechanism of coupling (one bond, germinal, vicinal and long range coupling), First order & non first order spectra - Chemical & magnetic equivalence, shift reagents, NMR instrumentation –Applications

UNIT – III NMR SPECTROSCOPY – II (15 Hours)

^{13}C NMR - The ^{13}C nucleus – Chemical shifts – Spin – spin splitting –Double resonance techniques - Homonuclear & heteronuclear decoupling – NOE- Broad band decoupling – Off resonance decoupling – gauche effect -comparison of ^{1}H and ^{13}C NMR-elementary idea of 2D NMR

UNIT – IV EPR AND MOSSBAUER SPECT ROSCOPY (15 Hours)

EPR : introduction , factors affecting the g-value, limitations , instrumentation ,electron nucleus interaction , hyperfine interactions-isotropic and anisotropic coupling constants – spin Hamiltonian -applications

Mossbauer spectroscopy – Resonance fluorescence and absorption in nuclei - Mossbauer effect – apparatus - lamb Mossbauer factor – Mossbauer nuclides – formation of nuclides – standard reference absorber – applications – isomer shift – co-ordination chemistry of iron cyanides – Quadrupole splitting due to asymmetry – iron proteins.

UNIT – V PHOTOACOUSTIC SPECTROSCOPY AND SPECTROSCOPIC APPLICATIONS (15 Hours)

PAS: Principle –Photoacoustic effect – Photoacoustic spectra – instrumentation – advantages of PAS over conventional absorption spectroscopy – Applications and surface applications of PAS.

Spectroscopic applications: Structural elucidation of simple organic molecules using UV-VIS, IR and NMR spectral techniques. Molecular formula of organic compounds restricted to 12 carbons.

Reference books:

1. Physical Methods in Inorganic Chemistry, R.S. Drago, Reinhold Saunders College Publishing ,1977
2. Organic Spectroscopy, William Kemp.3rd edition, ELBS Publications, 1975.
3. Jag Mohan, Organic Spectroscopy, Narosa Publishing House, 2nd Edition, 2009.
4. Spectroscopy , B.K.Sharma , Goel Publishing House ,2011
5. Instrumental methods of chemical analysis, G.W.Ewing, Mcgraw hill pub,1975
6. P.S.Kalsi, Spectroscopy, New Age International (P) Ltd, reprint 2009
7. D. L. Pavia, G.M. Lampman & G.S.Kriz Introduction to Spectroscopy, 3rd Edition, Brooks/Cole Publications, 2008,
8. R.M. Silverstein, F.X. Webster, Spectrometric Identification of Organic Compounds, 6th Edition, John Wiley Publications, 2009

Core Practical - I
ORGANIC CHEMISTRY PRACTICAL I

OBJECTIVES

- To perform the qualitative analysis of a given organic mixture.
- To carry out the preparation of organic compounds.

I. Identification of components in a two component mixture and preparation of their derivatives. Determination of boiling point/melting point for components and melting point for their derivatives.

II. Preparation.

1. Beta naphthyl methyl ether from beta naphthol
2. s-Benzyl isothiuronium chloride from benzylchloride
3. Beta glucose penta acetate from glucose
4. ortho-Benzoyl benzoic acid from phthalic anhydride
5. Resacetophenone from resorcinol
6. para-Nitrobenzoic acid from para nitrotoluene
7. meta-Nitroaniline from meta dinitrobenzene
8. Methyl orange from sulphanilic acid
9. Anthraquinone from anthracene
10. Benzhydrol from benzophenone.

Reference Books:

1. B.S.Furniss, A.J.Hannaford, P.W.G.Smith and A.R.Tatchell, Vogel's Practical Organic Chemistry.5th Edn., ELBS, 1989.

2. Raj K.Bansal, Laboratory manual of Organic Chemistry, III Edn., New Age International (P) Ltd.1996.

Core Practical - II
INORGANIC CHEMISTRY PRACTICAL I

OBJECTIVES

- To perform the semi micro qualitative analysis.
- To estimate the metal ions by colorimetric methods.
- To prepare inorganic complexes.

Part I

Semimicro qualitative analysis of mixtures containing two common and two rare cations. The following are the cations to be included: W, Tl, Mo, Te, Se, Ce, Th, Be, Zr, V, U and Li..

Part II

a) Colorimetric analysis : Visual and Photometric; determination of iron, nickel, manganese and copper.

b) Preparation of the following:
   a) Potassium trioxalatoaluminate (III) trihydrate
   b) Tristhioureacopper(I) chloride
   c) Potassium trioxalatochromate (III) trihydrate
   d) Sodium bis (thiosulphato) cuprate (I)
   e) Tetramminecopper (II) sulphate
   f) Potassium Tetrachlorocuprate (II)

References Books:

1. G.Svehla, Vogel's qualitative Inorganic analysis, VI Edition, Orient Longman, 1987.
2. V.V.Ramanujam, Inorganic Semimicro Qualitative analysis, National Publishing Co., 1971.

Core Practical - III
PHYSICAL CHEMISTRY PRACTICAL I

OBJECTIVES

- To perform experiments in chemical kinetics, phase rule and chemical equilibrium.
- To perform experiments in conductometry.

LIST OF EXPERIMENTS

1. Study the kinetics of acid hydrolysis of an ester, determination of the temperature coefficient of the reaction and determination of the activation energy of the hydrolysis of ethylacetate.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half life method and determine the order with respect to iodine and acetone.
3. Construction of phase diagram for a simple binary system (naphthalene – phenanthrene and benzophenone – diphenylamine).
4. Determination of the rate constant and order of reaction between potassium persulphate and potassium iodide and determine the temperature coefficient and energy of activation of the reaction.
5. Determination of equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculation of the dissociation constant of the acid.
6. Determination of equivalent conductivity of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.
7. Conductometric titrations of a mixture of HCl and CH_3COOH against Sodium hydroxide
8. Determination of the activity coefficient of an electrolyte at different molalities by emf measurements.
9. Determination of the dissociation constant of acetic acid by titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
10. Determination of the P^H of a given solution by emf method using hydrogen electrode and quinhydrone electrode.
11. Determination of the partial molar volume of glycine/methanol/formic acid/ sulphuric acid by graphical method and by determining the densities of the solutions of different compositions.
12. Study the surface tension – concentration relationship of solution (Gibb's equation)
13. Determination of the viscosities of mixtures of different composition of liquids and find the composition of a given mixture.

Reference Books:

1. B.P.Levitt (Ed.). Findlay's Practical Physical Chemistry, 9th Edn., Longman, London, 1985.
2. J.N.Gurtu and R.Kapoor, Advanced Experimental Chemistry, Vol I.S.Chand & Co. Ltd., New Delhi, 1980.

Model Question Paper
M.Sc. Branch IV (D) - Organic Chemistry
First Semester
Core Paper - I
Organic Chemistry - I

Time : 3 hours Maximum : 75 marks

PART - A (5X5=25 Marks)

Answer all the questions

1. a) Discuss briefly the optical activity of allenes and spiranes.
   or
   b) Discuss the conformation and stability of decalins.
2. a) Discuss the mechanism of sandmeyer reaction.
   or
   b) State and explain Hammonds postulate with potential energy diagram.
3. a) What are known as ambident nucleophiles? Mention some important ambident nucleophiles.
   or
   b) Explain the nature of attacking nucleophile and mention the important principles.
4. a) What is Zeigler alkylation? Comment on the uses of this reaction.
   or
   b) Explain the mechanism of vilsmeir reaction.
5. a) How is the position of methoxy group in reserpine estabilished?
   or
   b) Give the synthesis of Anthocyanins.

PART - B (5X10=50 Marks)

Answer all the questions

6. a) Explain the homotopic, enantiotopic and diastereotopic H atoms and groups in organic molecules. (10)
   b) Discuss the conformation, relative stability and optical activity of 1,2 and 1,3 dimethyl cyclohexanes. (10)
7. a) i) Explain Fischer projection with an example.
   ii) Discuss the optical activity of biphenyls. 5+5
   or
   b) Discuss the mechanism of the following reactions
   i) Pschorr reaction ii)Hunsdiecker reaction. 5+5
8. a) Explain SN^1 and SN^2 mechanism with suitable examples. (10)
   or
   b) Describe the mechanism of the following reactions.
   i) Williamson's reaction ii) Dieckmann condensation
   iii) Von - braun reaction 3+4+3

9. a) Explain arenium ion mechanism with evidences and energy profile diagram. (10)

or

b) Explain the mechanism of the following reactions
i) Chichibabin ii)Benzyne intermediate mechanism (10)

10. a) Elucidate the structure of Papaverine. (10)

or

b) Elucidate the structure of flavones. (10)

SECOND YEAR
THIRD SEMESTER
Core Paper – VI
ORGANIC CHEMISTRY - III
[75 Hours]

OBJECTIVES

- To learn the mechanism of addition to Carbon - Carbon and Carbon - Hetero atom multiple bonds.
- To learn the mechanism of molecular rearrangements.
- To study the mechanism of oxidation and reduction reactions.
- To study the structural elucidation of steroids.
- To study ORD, CD and mass spectrometry of organic compounds.

UNIT – I Addition to Carbon – Carbon and Carbon – Hetero atom multiple bonds. (15 Hours)

Addition of halogen and nitrosyl chloride to olefins, hydration of olefins and acetylenes, hydroboration, hydroxylation - cishydroxylation (OsO_4 & $KMnO_4$), transhydroxylation (Prevost reaction and Woodward modification), epoxidation, Michael addition, 1,3 dipolar addition, carbenes and their additions, Diels- Alder reaction.

Mechanism and applications of Mannich, Stobbe, Darzen Glycidic ester condensation. Benzoin condensation, Peterson olefination (Silyl Wittig reaction), Strecker synthesis, Wittig, Wittig - Horner, Perkin, Thorpe, Ritter, Prins reactions.

UNIT – II Molecular Rearrangements (15 Hours)

A detailed study of the mechanism of the following rearrangements. Wagner – Meerwin, Demyanov, Dienone- Phenol, Favorski, Baeyer – Villiger, Wolff, Stevens, Von – Richter, Beckmann, Hydroperoxide, Smiles, Jacobsen, Hofmann - Martius rearrangements (a few examples in each rearrangement are to be studied).

UNIT III Oxidation and Reduction Reactions (15 Hours)

Study of the following oxidation reactions with mechanism: Oxidation of alcohols by CrO_3, DMSO alone, DMSO in combination with DCC; acetic anhydride and oxalyl chloride, oxidation of arylmethane, oxidation of methylene alpha to carbonyl, allylic oxidation of olefins, oxidative cleavage of glycols, oxidative cleavage of double bonds by ozonolysis.

Study of the following reduction reactions with mechanism; Reduction of carbonyl compounds by complex metal hydrides (LAH, $NaBH_4$, $NaBH_3CN$), clemmensen and Wolff Kishner reductions, Birch reduction, MPV reduction.

UNIT IV Steroids (15 Hours)

Structure and Stereochemistry of Cholesterol. Total synthesis of Cholesterol and oestrone. Reactions of Oestrone, Conversion of cholesterol into progesterone, testosterone and oestrone. Artificial hormones – Stilboestrol and Hexoestrol.

UNIT – V ORD - CD and Mass Spectrometry (15 Hours)

ORD-CD: Definition, deduction of absolute configuration, octant rule for ketones, Cotton effect-axial haloketone rule.

Mass spectra – Basic principle, molecular ion peak, base peak, meta stable ion peak, isotopic peaks, Nitrogen rule, ring rule, McLafferty rearrangement, rules for fragmentation pattern, Examples of mass spectral fragmentation of organic compounds (alkanes, aromatic hydro carbons, alkyl halides, aldehydes, ketones, alcohols, acids and esters).

Text Books :

1. Jerry March, Advanced Organic Chemistry-Reactions, Mechanisms and Structure, Fourth Edition, John Wiley & Sons (1992)
2. Francis A. Carey, Organic Chemistry, Third Edition, The McGraw-Hill Companies, Inc., 1996.
3. P.S. Kalsi, Organic Reactions and Mechanisms, Second Edition, New Age International Publishers, 2002.
4. I.L. Finar, Organic Chemistry, Volume II, Fifth Edition, First Indian reprint, Pearson Education Asia Pte. Ltd., (2000)
5. G. Chatwal, Organic Chemistry of Natural Products, Vol I & II, Himalaya Publishing House, 1988.

Reference Books :

1. S. H. Pine, J.B. Hendrickson, D.J. Cram and G.S. Hammond, Organic Chemistry, IV Edn., McGraw Hill Company, 1980.
2. S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Edition, Macmillan, 1984.
3. R.T. Morrison and R.N. Boyd, Organic Chemistry, Prentice-Hall, VI Edition, 1992.
4. Neil Issac, Physical Organic Chemistry, J. Wiley, New York, 1987.
5. Paul de Mayo, Molecular Rearrangements, Vol I, Vol II, Interscience, NY. 1963.
6. S.W. Pelletier, Van Nostrand, Chemistry of Alkaloids, Reinhold, 1970.
7. Hendry, The Plant Alkaloids, Churchill Publishers, IV Edn., 1949.
8. Fisher and Fisher, Steroids, Reinhold, 1959.
9. O.P. Agarwal, Chemistry of Organic Natural Products, Vol I & II, Goel Publishing House, 1988.

CORE - VII
INORGANIC CHEMISTRY-II
(75 Hours)

Objectives:

i) To study about the X-ray crystal structure of the compounds

ii)To learn about the analytical tools which are used in nuclear chemistry

Unit - I Crystal Systems and Structural Analysis (15 Hours)

The growth and form of crystals - the crystal systems and Bravais lattices - Miller indices and labelling of planes - symmetry properties - crystallographic point groups and space groups - fundamentals of X-ray diffraction - powder and rotating crystal methods - systematic absences and determination of lattice types - analysis of X-ray data for cubic system - structure factor and Fourier synthesis - electron and neutron diffraction and structure determination.

Unit - II Solid State - I (15 Hours)

Types of solids - close packing of atoms and ions - bcc , fcc and hcp voids - Goldschmidt radius ratio - derivation - its influence on structures - structures of rock salt - cesium chloride - wurtzite - zinc blende - rutile - fluorite - antifluorite - diamond and graphite - spinel - normal and inverse spinels and perovskite - lattice energy of ionic crystals - Madelung constant - Born-Haber cycle and its applications.

Unit - III Solid State - II (15 Hours)

Metallic state - free electron and band theories - non - stoichiometry - point defects in solids - Schottky and Frenkel defects - linear defects - dislocations - effects due to dislocations - electrical properties of solids - insulators - intrinsic semiconductors - impurity semiconductors (n and p- type) and superconductors - elementary study of liquid crystals.

Unit - IV Nuclear Chemistry - I (15 Hours)

Nucleus: nuclear structure - stability of nuclei - packing fraction - even - odd nature of nucleons - n/p ratio - nuclear potential - binding energy and exchange forces - shell model and liquid drop model. Decay of radionuclei: rate of decay - determination of half-life period - secular equilibrium and decay series. Modes of decay: alpha, beta, gamma and orbital electron capture - nuclear isomerism - internal conversions - Q value - nuclear cross section - threshold energy and excitation functions. Particle acceleration and counting techniques: linear accelerator - cyclotron and synchrotron - betatron - G. M. counter - proportional and scintillation counters.

Unit - V Nuclear Chemistry - II (15 Hours)

Different type of nuclear reactions with natural and accelerated particles - transmutation - stripping and pick-up - spallation - fragmentation, etc. - fission - characteristics of fission reaction - product distribution and theories of fission - fissile and

fertile isotopes - U235, U238, Th232 and Pu239 - atom bomb - nuclear fusion - stellar energy - synthesis of new elements - principles underlying the usage of radioisotopes in analysis - agriculture - industry and medicine - mechanism of chemical reactions - uses of radioisotopes in analytical chemistry - isotopic dilution analysis - neutron activation analysis and dating methods.

Text Books:

1. W.J.Moore – Physical Chemistry
2. L.V.Azroff – Introduction to solids
3. S.Glasstone – Source book on atomic energy
4. H.J.Arnikar – Essentials of Nuclear chemistry.

Reference Books:

1. W.E.Addision – structural principles of Inorganic Chemistry
2. N.B.Hannay – Solid state chemistry
3. R.A.Alberty – Physical chemistry
4. G.Friedlander, J.W.Kennedy, - Nuclear and Radiochemistry
   E.S.Macias and J.M.Miller

CORE - VIII
PHYSICAL CHEMISTRY III [75 Hours]

OBJECTIVES

- To impart knowledge on electrochemistry, photochemistry, quantum chemistry, and spectroscopy
- To study the concepts and principles of electrochemistry, photochemistry, quantum chemistry, and spectroscopy

UNIT – I Electrochemistry – I (15 Hours)

Ions in solutions – Debye – Huckel theory of strong electrolytes – Debye – Huckel – Onsager equation – verification and limitation – Debye – Huckel limiting law and its extension. Electrode – Electrolyte interface - adsorption at electrified interface – electrokinetic phenomena – Tiselius method of separation of proteins – Membrane potential- Lippmann capillary equation – Electrical double layers – Helmholtz Perrin, Gouy- Chapman and Stern models.

UNIT – II Electrochemistry – II (15 Hours)

Polarisation and over voltage – Butler Volmer equation- diffusion current-echange and equilibrium current density-Hydrogen and oxygen evolution reactions. Corrosion and passivation of metals – Pourbaix and Evans diagrams – Prevention of corrosion. Electrochemical energy systems – Primary and secondary batteries – (dry cells, lead acid storage batteries, silver- zinc cell, nickel -cadmium battery) –Fuel cells – Electrodeposition – principles and applications.

UNIT – III Photochemistry (15 Hours)

Absorption and emission of radiation – decay of electronically excited states – radiative and non –radiative processes – Fluorescence and Phosphorescence – Prompt and delayed fluorescence – quenching of fluorescence – static and dynamic quenching; Stern – Volmer equation – Excimers and exciplexes - Kinetics of Photochemical reactions – Photosensitized reactions. Photovoltaic and photogalvanic cells – photoelectrochemical cells – solar cells- solar energy conversion.

UNIT - IV Quantum Chemistry – III (15 Hours)

Theory of chemical bonding – Born – Oppenheimer approximation – LCAO – MO approximation for hydrogen molecule ion and hydrogen molecule – Valence Bond theory of hydrogen molecule – Concept of hybridisation – sp, sp^2 and sp^3 hybridisation – Huckel Molecular orbital (HMO) theory for conjugated π- systems-application to ethylene, butadiene and benzene – Self consistent field approximation – Hartree and Hartree – Fock self consistant field theory .

Unit – V Spectroscopy (15 Hours)

Rotational spectroscopy – Rigid Rotor – Intensity of spectral lines – Effect of isotopic substitution on the rotation spectra . Vibrational spectroscopy – harmonic oscillator –

anharmonic oscillator – Hot bands – selection rules – Overtones and combination frequencies – Fermi Resonance. Raman spectroscopy – Raman effect (quantum theory) - Rotational and Vibrational Raman Spectra – Mutual Exclusion Rule. Electronic spectroscopy – Electronic spectra of diatomic molecules – vibrational coarse structure – Franck – Condon Principle.

Text Books:-

1. S. Glasstone, Introduction to Electro Chemistry, Affiliated East West Press, New Delhi, 1960.
2. D.R. Craw, Principles and applications of Electro chemistry, Chapman and Hall, 1991.
3. J. Robbins, Ions in solution – An Introduction to Electro chemistry, Clarendon Press, Oxford (1972).
4. K.K. Rohatgi Mukherjee, Fundamentals of Photochemistry, Wiley Eastern Ltd., 1978.
5. N.J. Turro, Modern Molecular Photochemistry, Benjamin / Cummings, Menlo park, California (1978).
6. R.K. Prasad, Quantum Chemistry, Wiley Eastern, NewDelhi, 1992.
7. M.W. Hanna, Quantum Mechanics in Chemistry, W.A. Benjamin Inc, London 1965.
8. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Mc Graw Hill, Newyork, 1966.

Reference Books:-

1. J.O.M. Bockris and A.K.N. Reddy, Electrochemistry, Vols, 1 and 2, Plenum, New York. 1977.
2. C.M.A Brett and A.M.O. Brett, Electrochemistry, Principles, Methods and Applications, OUP, Oxford, 1993.
3. R.H. Rieger, Electrochemistry, Chapmann and Hall, New York (1994).
4. P. Delahay, Electrode Kinetics and Structure of Double Layer, Interscience, 1965.
5. J.C. Calvert and J.N. Pitts, Photochemistry, Wiley, London, 1966.
6. R.P. Wayne, Photochemistry, Butterworths, London, 1970.
7. R.P. Cundell and A.Gilbert, Photochemistry, Thomas Nelson, London, 1970
. 8. C.K. Depuy and O.L. Chapman, Molecular reactions and Photochemistry.
9. A.K. Chandra, Introductory Quantum Chemistry, Tata McGraw Hill.
10. D.A. McQuarrie, Quantum Chemistry, University Science Books, Mill Valley, California (1983).
11. P.W. Atkins, Molecular Quantum Mechanics, Oxford University Press, Oxford, 1983.
12. Raymond chang, Basic Principle of Spectroscopy, McGraw Hill Ltd., New York (1971).
13. G.M. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill, New York, 1962

ELECTIVE PAPER - IIIA
EXPERIMENTAL METHODS IN CHEMISTRY
(75 Hours)

OBJECTIVES

- To study in detail the fundamental aspects of various experimental and instrumental methods in chemistry
- To understand the principles and instrumentation of destructive and non-destructive techniques
- To understand the various techniques in Chromatography

UNIT – I SURFACE IMAGING (15 Hours)

Basic concepts in surface imaging – Principle, Instrumentation and Applications – secondary electron microscopy(SEM), secondary Auger microscopy(SAM), scanning probe microscopy(SPM), scanning tunneling microscopy(STM), transmission electron microscopy(TEM).

UNIT – II CHEMICAL ANALYSIS (15 Hours)

Non-destructive techniques – X-ray absorption , Diffraction and fluorescence spectroscopy – theory, instrumentation and applications.

Destructive technique – Atomic absorption spectroscopy – principle, instrumentation –EMR sources – cells – furnaces – detectors – interferences and their corrections – applications of AAS.

UNIT – III ELECTROANALYTICAL TECHNIQUES (15 Hours)

Polarography – Theory, apparatus , DME, diffusion, kinetic and catalytic currents, current voltage curves for reversible and irreversible systems, qualitative and quantitative applications to inorganic systems.

Amperometric titrations – Theory, apparatus, types of titration curves, successive titrations and two indicator electrodes , applications – Complexometric titrations – chelating agents, types of EDTA titration – direct and back titrations, replacement titrations – masking and demasking reagents.

UNIT – IV SEPARATION METHODS - I (15 Hours)

Normal and Reversed-phase liquid chromatography – Theory and applications – HPLC – principle, instrumentation, apparatus and materials, column efficiency and selectivity , applications – GC chromatography – principle, instrumentation, retention volume, resolution and applications.

UNIT – V SEPARATION METHODS – II (15 Hours)

Gel chromatography or Gel Permeation Chromatography – Principle, Materials, Gel preparation, column Packing and Detectors – applications and advantages of gel chromatography.

Ion Exchange Chromatography – Definition, Principle, cation and anion exchangers – regeneration - column used in separations - Ion exchange capacity and techniques - Applications

Text books:

1. R.Wiesendanger, scanning probe microscopy and spectroscopy, Cambridge university press, 1994
2. Frank A.Settle, Handbook of instrumental techniques for analytical chemistry, Prince Hall , Newjersey,1997
3. Gurdeep R. Chatwal, Sham K. Anand, Instrumental methods of chemical analysis, Himalaya Publishing House,2011
4. P.Atkins and J.de paula atkins, Physical chemistry, 8th Ed., Oxford university Press, Newdelhi, 2008
5. F.scholz, Electroanalytical methods, Springer,2nd Ed.,2010.

Elective Paper-IIIB
ELECTROANALYTICAL CHEMISTRY
(75 Hours)

OBJECTIVES

- To understand the basic concepts of electroanalytical chemistry
- To study the principles and instrumentation of various electroanalytical techniques

UNIT I Basic Electrochemical principles (15 Hours)

Mass transfer processes – migration, diffusion and convection– planar and spherical diffusion – Reversible and Irreversible processes.

UNIT II Methods Based on Diffusion (15 Hours)

Principle, instrumentation and applications of the following techniques: Chronoamperometry; Polarography - Ilkovic equation - Square wave polarography; Linear Sweep voltammetry – Randles Sevrik equation; Cyclic voltammetry - Normal pulse, Differential pulse and Squarewave voltammetry.

UNIT III Coulometric and Potentiometric Methods (15 Hours)

Galvanostatic and potentiostatic methods. Principle, instrumentation and applications of the following techniques: Controlled potential coulometry and electrolysis; Chronocoulometry; Potentiometry and Chronopotentiometry.

UNIT IV Stripping voltammetry (15 Hours)

Principle, instrumentation and applications of Anodic stripping voltammetry, Cathodic stripping voltammetry and Adsorptive stripping voltammetry.

UNIT V Sine wave methods (Electrochemical Impedance Spectroscopy) (15 Hours)

Principle of Impedance technique - Analysis of Faradaic impedance – Bode Diagrams.

Dynamic electrode techniques, Principle, instrumentation and applications of RDE and RRDE techniques.

Text Books

1. D.A.Skoog and D.M.West, Fundamentals of Analytical Chemistry, Holt Rinehart and Winston Publications, IV Edn, 1982.
2. Willard, Merit, Dean and Settle, Instrumental Methods of Analysis, CBS Publishers and Distributors, IV Edn. 1986

Reference Books

1. B. H. Vassos and G.W. Ewing, Electroanalytical Chemistry, John Wiley and Sons, NY, 1983.
2. A. J. Bard and L.R. Faulkner, Electrochemical methods; Fundamentals and applications, J. Wiley and Sons, NY, 1980,
3. J.Wang, Stripping Analysis, VCH Publications, 1985.
4. A.M. Bond, Modern Polarographic methods in analytical chemistry, Macel Decker Inc., 1980.

SEMESTER - IV
Core Paper - XI
INORGANIC CHEMISTRY-III
(75 Hours)

Objectives:

1. To learn the detailed study of synthetic organometallic complexes owing to the preparation as well as their reactivity and application which is very useful in the modern era.

Unit - I Bonding in Organometallic Complexes and metal carbonyls (15 Hours)

Definition of organometallic compound - 18 electron rule - effective atomic number rule - classification of organometallic compounds - the metal carbon bond types - ionic bond – sigma covalent bond - electron deficient bond - delocalised bond - dative bond - metal carbonyl complexes - synthesis - structure and reactions of metal carbonyls - the nature of M-CO bonding- binding mode of CO and IR spectra of metal carbonyls - metal carbonyls- metal carbonyl anions - metal carbonyl hydrides - metal carbonyl halides - metal carbonyl clusters – Wade‟s rule and isolobal relationship.

Unit - II MetAL aLkyl, Alkylidene and Alkylidyne complexes (15 Hours)

Metal alkyl complexes - stability and structure - synthesis by alkylation of metal halides - by oxidative addition - by nucleophilic attack on coordinated ligands - metal alkyl and 18 electron rule - reactivity of metal alkyls - M-C bond cleavage reactions - insertion of CO to M-C bonds - double carbonylation - insertions of alkenes and alkynes - insertions of metals with C-H bonds - alkylidene and alkylidyne complexes - synthesis of alkylidene complexes in low oxidation states and in high oxidation states - bonding in alkylidene complexes - synthesis and bonding in alkylidyne complexes - reactivity of alkylidene and alkylidyne complexes.

Unit - III Metal Alkene and Alkyne complexes (15 Hours)

Alkene complexes - synthesis of alkene complexes by ligand substitution - by reduction and by metal atom synthesis - bonding of alkenes to transition metals - bonding in diene complexes - reactivity of alkene complexes - ligand substitution - reactions with nucleophiles - olefin hydrogenation - hydrosilation - Wacker process - C-H activation of alkenes - alkyne complexes - bonding in alkyne complexes - reactivity of alkynes - alkyne complexes in synthesis - cobalt catalysed alkyne cycloaddition.

Unit - IV Organometallic Sandwich complexes (15 Hours)

Cyclopentadienyl complexes - metallocenes - synthesis of metallocenes - bonding in metallocenes - reactions of metallocenes - Cp2Fe/Cp2Fe+ couples in biosensors - bent sandwich complexes - bonding in bent sandwich complexes - metallocene halides and hydrides - metallocene and stereospecific polymerisation of 1-alkenes - cyclopentadiene as a non-spectator ligand - arene complexes - synthesis - structure and reactivity of arene complexes - multidecker complexes.

Unit - V Organometallic Chemistry applications in catalysis. (15 Hours)

Organometallic compounds in homogeneous catalytic reactions - coordinative unsaturation - acid-base behaviour reaction - migration of atoms or groups from metal to ligand - insertion reaction - reactions of coordinated ligands - catalytic reactions of alkenes - isomerisation of alkenes - hydrogenation - hydroformylation and hydrosilation of alkenes - fluxional molecules.

Text Books:

1. Basic organometallic chemistry, J. Haiduc and J. J. Zuckerman, Walter de Gruyter, Brelin, 1985.
2. Inorganic Chemistry - Priciples of structure and reactivity, J. E. Huheey Harper International Edition, Harper and Rone New York, 1978.
3. Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, Fourth Edition.

Reference Books:

1. Organometallics 1, complexes with transition metal-carbon -bonds, Bockmann, Oxford science publications, Oxford, 1996.
2. Organometallics 2, complexes with transition metal-carbon -bonds, Bockmann, Oxford science publications, Oxford, 1996.

ELECTIVE PAPER - IVA
NANO AND GREEN CHEMISTRY
[75 Hours]

OBJECTIVES

- To understand the characterization of nanomaterials
- To understand carbon clusters and nanostructures
- To understand the green concepts of organic reactions

UNIT – I INTRODUCTION TO NANOSCIENCE (15 Hours)

Definition, classification, a historical perspective, nanoparticles, nanocrystal, quantum dot, nanometer, new properties of nanomaterials, nanomaterials in medicine, information storage, sensors, new electronic devices, environmental remediation, clean catalyst. Metal nanoparticles, chemical bonding and properties of bulk metals as well as metal nano particles. Gas phase and chemical synthetic methods to metal nanoparticles, nanoelectrons, conductivity of nanoelectrons.

UNIT – II TOOLS OF THE NANOSCIENCES (15 Hours)

Tools to measuring nanostructures – scanning probe instruments – spectroscopy – electrochemistry – electron microscopy (Basic ideas only).

Tools for make nanostructures – the return of scanning probe instruments – nanoscale lithography – molecular synthesis – self assembly - nanoscale crystal growth – polymerization - nanobricks and building blocks.

UNIT – III PROPERTIES AND APPLICATIONS OF NANAOPARTICLES (15 Hours)

Nanotubes(CNT), nanocrystal shape, sequestration of gases, destructive adsorption of environmental toxins, optical properties and magnetic properties of nanoscale materials . Size dependent properties such as coercivity(magnetic memory) and saturation magnetization, nanoparticles in polymers, ink, fluids, dyes and catalysis. Nanoparticles as colorants, ultraviolet absorbers, electronics and in biomedical applications.

UNIT – IV INTRODUCTION TO GREEN CHEMISTRY (15 Hours)

Choice of starting materials, choice of reagents, choice of catalysts – biocatalysts, polymer supported catalysts, choice of solvents. Synthesis involving basic principles of green chemistry – examples – synthesis of adipic acid, methyl methacrylate, paracetamol. Ultrasound assisted reactions – esterfication, reduction, coupling reactions. Strecker synthesis and reformatsky reaction.

UNIT – V SOLVENT FREE ORGANIC SYNTHESIS (15 Hours)

Reactions on solid supports, phase transfer catalysis, solvent free esters saponification, reactions without support or catalyst, examples – microwave assisted reactions in water – oxidation of toluene to benzoic acid, microwave assisted reactions in organic solvent - Diels alder reaction, coupling reactions(stille,Suzuki,heck,sonogashira) - Solvent free microwave

assisted organic synthesis – microwave activation and heating, advantages of microwave exposure and specific effects of microwaves - Organic synthesis under microwaves – benefits and limitations.

Text books.

1. Kenneth.klabunde, Nanoscale Materials in Chemistry, John Wiley & Sons, Inc.2002
2. Mark Ratner,Daniel Ratner, Nanotechnolgy,Pearson Education,Inc.2007
3. Mick Wilson, Kannangara,Geoff Smith,Michelle simmons and Burkhard Raguse, Nanotechnology basic science and emerging technologies, overseas press.
4. Rashmi Sanghi,M.M.Srivastava, Green Chemistry, Environment friendly Alternatives , narosa Publishing house, 2007
5. V.Kumar, An introduction to Green Chemistry, Vishal Publishing co. Jalandhar, 2007

ELECTIVE PAPER - IVB
MEDICINAL CHEMISTRY
(75 Hours)

Objectives

1. To understand the basic concepts of medicinal chemistry
2. To understand the structure activity relationships of selected drug molecules

Unit I Basic Concepts (15 Hours)

Drug design - analogues and pro-drugs, factors governing drug design, rational approach,method of variation and tailoring of drugs; Physical properties-factors governing drug action at active site, factors governing ability of drugs to reach active site, dissociation constants, isosterism and bioisosterism; general anaesthetics-inhalation anaesthetics, intravenous anaesthetics and basal anaesthetics;mode of action; local anaesthetics-classification and syntheses, sedatives and hypnotics-classification, synthesis, mode of action and structure-activity relationship.

Unit II Anticonvulsants, Stimulants and Antipyretic Analgesics (15 Hours)

Anticonvulsants - classification, synthesis and mode of action; Muscle relaxants-classification, synthesis and mode of action. Central nervous system stimulants-classification, synthesis and mode of action; Antipyretic analgesics- classification, synthesis and mode of action;

Unit III Other Analgesics (15 Hours)

Narcotic or Opiate analgesics - classification, preparation and mode of action; Narcotic antagonists; Cardiovascular drugs-classification, synthesis and mode of action; Autonomic drugs-synthesis and mode of action of sympathomimetic drugs, antiadrenergic drugs, cholinomimetic drugs, antimuscarinic drugs, ganglionic blocking agents and adrenergic neurone blocking agents; Diuretics - synthesis and mode of action of mercurial and non-mercurial diuretics.

Unit IV Antihistamines, Anti-inflammatory and Antiparkinson drugs (15 Hours)

Antihistaminics - synthesis and mode of action of histamine H_1 receptor antagonists and histamine H_2-receptor blockers; prevention of histamine release; structure-activity

relationships amongst H_1-receptor blockers. Non-steroidal anti-inflammatory drugs(NSAID)-synthesis and mode of action of heteroarylacetic acid analogues, arylacetic acid analogues, arylpropionic acid analogues, naphthalene acetic acid analogues, gold compounds, salicylic acid analogues and pyrazolones and pyrazolodiones; Antiparkinsonism agents-synthesis and mode of action of piperidine analogues, pyrolidine analogues and phenothiazine analogues.

Unit V Other drugs (15 Hours)

Expectorants and antitussives-synthesis and mode of action of sedative expectorants, stimulant expectorants and centrally acting antitussive agents. Sulphonamides-preparation and mode of action of sulphonamides for general, urinary, intestinal and local infection; sulphonamide inhibition. Antimalarials-synthesis and mode of action of aminoquinoline analogues, aminoacridine analogues, guanidine analogues, pyrimidine analogues, sulfone and quinine analogues; Steroids-synthesis and mode of action of sterols, sex harmones, cardiac glycosides, bile acids and sapogenins. Antibiotics-synthesis and mode of action of penicillins, aminoglycoside antibiotics, chloramphenicol and tetracyclines.

Text Books

1. Ashutosh Kar, Medicinal Chemistry, New Age International, 1996.
2. W.O.Foye, Principles of medicinal chemistry, 2nd edn., Lea & Febiger, Philadelphia, 1981.

Reference Books

1. M.E.Wolff, Burger's medicinal chemistry, 4th Edn., John Wiley &Sons, New York, 1981.
2. F.F.Blicke and R.H.Cox, Medicinal Chemistry, John Wiley &Sons, New York, 1959.
3. D.Lednicer and L.A.Mitscher, Organic Chemistry of drug synthesis, John Wiley & Sons, New York, 1959.
4. J.E.Hoover, Remington's Pharmaceutical sciences, 15th Edn. Mack Publ.Company, Easton, 1975.

Core Practical - IV

ORGANIC CHEMISTRY PRACTICAL – II

OBJECTIVES

- To perform organic estimations
- To prepare organic compounds involving two stages.

I. Organic Estimation

1. Phenol
2. Aniline
3. Methyl Ketone
4. Glucose
5. Iodine value of an oil
6. Saponification value of an oil.

II. Organic Preparation, Involving Two stages

1. Sym-tribromobenzene from aniline.
2. m- Nitrobenzoic acid from methyl benzoate.
3. para – Nitroaniline from acetanilide.
4. Benzanilide from benzophenone.
5. Aspirin from methyl salicylate
6. Anthraquinone from phthalic anhydride.

III. Extraction of Natural Products:

1. Caffeine from tea leaves.
2. Citric acid from lemon.

IV Chromatographic Separations

1. Column chromatography : separation of a mixture of ortho and para-Nitroanilines.
2. Thin layer Chromatography: separation of a mixture of ortho and para – Nitroanilines.
3. Paper chromatography – identification of natural alpha amino acids.

Reference Books :

1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, Vogel's Practical Organic Chemistry. 5th edn. ELBS. 1989.
2. Raj K. Bansal, Laboratory manual of Organic Chemistry, III Edn., New Age International (P) Ltd. 1996.

Core Practical - V

INORGANIC CHEMISTRY PRACTICAL – II

OBJECTIVES

- To perform quantitative estimation of inorganic mixture.
- To perform analysis of ores and alloys
- To prepare inorganic complexes.

Part I Quantitative analysis of complex materials

A) Quantitative analysis:

Quantitative analysis of the following mixture

1. Iron and magnesium
2. Iron and nickel
3. Copper and nickel
4. Copper and Zinc

B) Analysis of Ores

1. Determination of percentage of calcium and magnesium in dolomite.
2. Determination of percentage of MnO_2 in pyrolusite
3. Determination of percentage of lead in galena.

C) Analysis of Alloys

1. Determination of tin and lead in solder
2. Determination of copper and zinc in brass.
3. Determination of Chromium and nickel in stainless steel.

Part II: Preparations of the following:

1. Sodium hexanitrocobaltate (III)
2. Sodium Trisoxalatoferrate (III)
3. Prussian blue $Fe_4[Fe(CN)_6]_3$
4. Bis (acetylacetanato) Copper (II)
5. Hexamminecobalt (III) chloride
6. Hexamminenickel (II) chloride

Reference Books:

1. G. Svehla, Vogel's qualitative Inorganic analysis, VI Edition, Orient Longman, 1987.

2. V.V. Ramanujam, Inorganic Semimicro Qualitative analysis. National Publishing Co., Chennai.1971.
3. J. Basset, R.C. Denney, G.H. Jeffery and J.Mendham Vogel's Text book of quantitative inorganic analysis, IV Edition, ELBS, 1985.
4. W.G. Palmer, Experimental Inorganic Chemistry, Van Nostrand Reinhold Co., London, 1972.
5. D.N. Grindley, An advanced course in practical Inorganic Chemistry, Butterworths, 1964.

Core Practical - VI
PHYSICAL CHEMISTRY PRACTICAL – II

OBJECTIVES

- To perform experiments in potentiometry, polorography and chemical kinetics.

Experiments in Electrochemistry, Polarography and Cheimcal Kinetics.

EMF Measurements

1. Determination of standard potentials (Cu and Ag)
2. Determination of thermodynamic quantities from EMF measurements
3. Potentiometric titrations.
4. Determination of pH and calculation of pKa.
5. Determination of stability constant of complex.
6. Determination of solubility product of a sparingly soluble salt, Redox titrations.
7. Precipitation titration of mixture of halides by emf measurements.

DETAILED LIST OF EXPERIMENTS

Typical list of possible experiments are given. Experiments of similar nature and other experiments may also be given. The list given is only a guideline. A minimum of 15 experiments have to be performed.

1. Determination of the activity coefficient of an electrolyte at different molalities by emf measurements.
2. Determination of the dissociation constant of acetic acid by titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
3. Determination of the strength of a given solution of KCl using differential potentiometric titration technique.
4. Determination of the pH of the given solutions with the help of the indicators using buffer solutions and by colorimetric method.
5. Determination of the pH of a given solution by emf method using hydrogen electrode and quinhydrone electrode.
6. Determination of the composition and instability constant of a complex by mole ratio method.
7. Calculation of the thermodynamic parameters for the reaction Zn + H_2SO_4 -------> $ZnSO_4$ + H_2 by emf method.
8. Determination of the formation constant of silver ammonia complex and stoichiometry of the complex potentiometrically.
9. Solubility and solubility products by emf method.
10. Determination of the activity coefficient of Zinc ions in the solution of 0.002M Zinc sulphate using Debye - Huckel Limiting law.
11. Determination of solubility product of Silver bromide and calculate its solubility in water and 0.1 M and 0.01 M $KBrO_3$ using Debye- Huckel limiting law.
12. Determination of the electrode potentials of Zn and Ag electrodes in 0.1 M and 0.001M solutions at 298 K and find the standard potentials for these electrodes and test the validity of Nernst equations.
13. Study the inversion of cane sugar in presence of acid using polarimeter.

14. Determination of the rate constant and order of reaction between potassium persulphate and potassium iodide and determine the temperature coefficient and energy of activation of the reaction.
15. Study the primary salt effect on the kinetics of ionic reactions and test the Bronsted relationship (iodide ion is oxidized by persulphate ion.)
16. Determination of the viscosities of mixtures of different compositions of liquids and find the composition of a given mixture.
17. Determination of the partial molar volume of glycine/methanol/formic acid/ sulphuric acid by graphical method and by determining the densities of the solutions of different compositions.
18. Study the surface tension – concentration relationship of solutions (Gibb's equation)

Reference Books:

1. B.P.Levitt (Ed.). Findlay's Practical Physical Chemistry, 9th Edn., Longman, London, 1985.
2. Practical Physical Chemistry - A.G.Md.S.Oolvi.
3. Senior Practical Physical Chemistry - Khosla, Garg & Adarsh Khosla.