TUMKUR UNIVERSITY

Faculty of Science
M. Sc. Chemistry - Course Structure (CBCS Scheme)
I Semester

Sl. No.	Paper	Title of the paper	Instruction Hours per Week	No. of Credits	Duration of Exam	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT-1.1	Concepts of Inorganic Chemistry	4	4	3 Hrs	20	80	100
2	CPT-1.2	Organic Reaction Mechanisms and Stereochemistry	4	4	3 Hrs	20	80	100
3	CPT-1.3	Thermodynamics and Quantum Chemistry	4	4	3 Hrs	20	80	100
4	SPT-1.4.A	Organic Synthesis	4	4	3 Hrs	20	80	100
	SPT-1.4.B	Automated, Electroanalytical Methods And Separation Technique	4	4	3 Hrs	20	80	100
5	CPP-1.5 (1.1)	Practical Inorganic Chemistry - I	4	2	5 Hrs	10	40	50
6	CPP-1.6 (1.2)	Practical Organic Chemistry - I	4	2	5 Hrs	10	40	50
7	CPP-1.7 (1.3)	Practical Physical Chemistry - I	4	2	5 Hrs	10	40	50
8	SPP – 1.8 (1.4.A)	Practical Organic Chemistry	4	2	5 Hrs	10	40	50
	SPP – 1.8 (1.4.B)	Practical Analytical Methods	4	2	5 Hrs	10	40	50
		Total	32	24				600

CPT: Core paper theory CPP: Core paper practical SPT: Special paper theory SPP: Special paper practical
OET: Open Elective Theory OEP: Open Elective practical

II Semester

S. No.	Paper	Title of the paper	Instruction Hours per Week	No. of Credits	Duration of Exam	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT- 2.1	Group Theory & Coordination Chemistry	4	4	3 Hrs	20	80	100
2	CPT- 2.2	Reaction Mechanism, Photochemistry and Spectroscopy	4	4	3 Hrs	20	80	100
3	SPT- 2.3.A	Statistical Mechanics, Electrochemistry and Spectroscopy	4	4	3 Hrs	20	80	100
	SPT- 2.3.B	Surface, Nuclear Chemistry and Non-Equilibrium Thermodynamics	4	4	3 Hrs	20	80	100
4	OET – 2.4	Fundamentals of Chemical Analysis & Chromatography	4	4	3 Hrs	20	80	100
5	CPP-2.5 (2.1)	Practical Inorganic Chemistry - 2	4	2	5 Hrs	10	40	50
6	CPP-2.6 (2.2)	Practical Organic Chemistry - 2	4	2	5 Hrs	10	40	50
7	SPP-2.7.A (2.3.A)	Practical Physical Chemistry	4	2	5 Hrs	10	40	50
	SPP-2.7.B (2.3.B)	Practical Physical Chemistry	4	2	5 Hrs	10	40	50
8	OEP 2.8 (2.4)	Quantitative analysis and Separation Techniques	4	2	5 Hrs	10	40	50
		Total	32	24				600

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III Semester

Sl. No.	Paper	Title of the paper	Instruction Hours per Week	No. of Credits	Duration of Exam	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT- 3.1	Reactions, Rearrangements and Heterocyclic chemistry	4	4	3 Hrs	20	80	100
2	CPT- 3.2	Chemical Kinetics and Surface Phenomena	4	4	3 Hrs	20	80	100
3	SPT- 3.3.A	Organometallic Chemistry & Inorganic spectroscopy	4	4	3 Hrs	20	80	100
	SPT- 3.3.B	Industrial and Materials Chemistry	4	4	3 Hrs	20	80	100
4	OET – 3.4	Environmental Chemistry	4	4	3 Hrs	20	80	100
5	CPP-3.5 (3.1)	Practical Organic Chemistry - 3	4	2	5 Hrs	10	40	50
6	CPP-3.6 (3.2)	Practical Physical Chemistry - 3	4	2	5 Hrs	10	40	50
7	SPP-3.7.A (3.3.A)	Practical Inorganic Chemistry	4	2	5 Hrs	10	40	50
	SPP-3.7.B (3.3.B)	Practical Inorganic Chemistry	4	2	5 Hrs	10	40	50
8	OEP-3.8 (OET-3.4)	Practical Environmental Chemistry	4	2	5 Hrs	10	40	50
		Total	32	24				600

CPT: Core paper theory CPP: Core paper practical SPT: Special paper theory SPP: Special paper practical
OET: Open Elective Theory OEP: Open Elective practical:

IV Semester

Sl. No.	Paper	Title of the paper	Instruction Hours per Week	No. of Credits	Duration of Exam	Marks		
						Internal Assessment	Semester End Exam	Total Marks
1	CPT- 4.1	Bioinorganic Chemistry and Catalysis	4	4	3 Hrs	20	80	100
2	CPT- 4.2	Macromolecules, Photochemistry and Solid State chemistry	4	4	3 Hrs	20	80	100
3	SPT- 4.3.A	Chemistry of Natural Products	4	4	3 Hrs	20	80	100
	SPT -4.3.B	Medicinal chemistry	4	4	3 Hrs	20	80	100
4	CPD-4.4	Core Paper Dissertation	4	4		20	80	100
5	CPP-4.5 (4.1)	Practical Inorganic Chemistry - 4	4	2	5 Hrs	10	40	50
6	CPP-4.6 (4.2)	Practical Physical Chemistry - 4	4	2	5 Hrs	10	40	50
7	SPP- 4.7 (4.3.A)	Practical Organic Chemistry –	4	2	5 Hrs	10	40	50
	SPP- 4.7(4.3.B)	Practical Organic Chemistry -	4	2	5 Hrs	10	40	50
8	Project 4.8	Core Paper Dissertation Practical	4	2	-	10	40	50
		Total	32	24				600

CPT: Core paper theory CPP: Core paper practical SPT: Special paper theory SPP: Special paper practical
OET: Open Elective Theory OEP: Open Elective practical CPD: Core Paper Dissertation CPDP: Core Paper Dissertation Practical

- Open Elective to be offered by other departments within the faculty
- Open Elective offered by chemistry department for others

Basis for Internal Assessment Marks Allotment for theory **Internal Assessment Marks for practicals: 10**

1st Test for 10 marks
2nd Test for 10 marks: Average of two tests : 10
Seminar : 05
Extra activities : 05
Total : **20 Marks**

THEORY QUESTION PAPER PATTERN
M.Sc. Chemistry (CBCS Scheme)

Note: Answer Question no. 1 and any FOUR of the remaining. Max. Marks = 80

1. Answer the following questions 8 X 2 = 16

(a)

(b)

(c)

(d)

(e)

(f)

(g)

(h)

2. Write short notes on any FOUR of the following 4 X 4 =16

(a)

(b)

(c)

(d)

(e)

3. 8+4+4=16

(a)

(b)

(c)

4. 8+4+4=16

(a)

(b)

(c)

5. 8+4+4=16

(a)

(b)

(c)

6. 8+4+4=16

(a)

(b)

(c)

***Note: Equal weightage to be given to each unit while preparing question paper.**

PRACTICAL QUESTION PAPER PATTERN

Max. Marks = 40

1.	Experiment and Spotting	30
2.	Practical record	05
3.	Viva-voce	05
	Total	**40 Marks**

Chairman
BOS in Chemistry

CPT – 1.1
Concepts of Inorganic Chemistry

UNIT - I — 16 Hours

Correlation of general properties of d-block elements with those of 4f and 5f elements.

Lanthanide series: Introduction, electronic structure, oxidation states, lanthanide contraction, abundance and extraction, lanthanides as shift reagents.

Separation of lanthanides: Solvent extraction and ion – exchange. Chemical properties of compounds of lanthanides in II, III, and IV oxidation states. Magnetic properties, colour and spectra.

Actinides: Electronic structure and position in the periodic table, oxidation states, occurrence and synthesis of the elements. Spectral and magnetic properties of compounds of actinides in comparison with those of lanthanides and d-block elements.

Uranium: Isotope separation / enrichment, Chemical properties, hydrides, oxides and halides. Chemistry of Trans – uranium elements.

UNIT-II — 16 Hours

Chemistry of Non-transition Elements: General discussion on the properties of the non-transition elements; special features of individual elements; synthesis, properties and structure of their halides and oxides, polymorphism of carbon, Phosphorous and Sulphur. Synthesis, properties and structure of boranes, carboranes, borazines, silicates, carbides, silicones, phosphazenes, sulphur-nitrogen compounds: peroxo compounds of boron, carbon and sulphur; oxy acids of nitrogen, phosphorous, sulphur and halogens and compounds of noble gas compounds.

UNIT – III — 16 Hours

Ionic Bond: Properties of ionic substances, structures of crystal lattices (NaCl, CsCl, ZnS, Wurtzite and rutile) Lattice energy, Born-Haber cycle, uses of Born-Haber type calculations, Born-Lande equation, Ionic radii, factors affecting the radii of ions, radius ratio effects, covalent character in ionic bonds, hydration energy and solubility of ionic compounds.

Covalent Bond: Concept of hybridization**,** M.O. Treatment for homonuclear and heteronuclear diatomic molecules. M.O. treatment involving delocalized π-bonding (CO_3^{2-}, NO_3^-, NO_2, CO_2 and N_3^-). Weak interactions in covalent substances. VSEPR model for explaining structure of molecules including fluxional molecules, short comings of the VSEPR model.

UNIT – IV — 16 Hours

Concepts of acids and bases: Lux - Flood and Usanovich concepts, solvent system and leveling effect. Hard – Soft Acids and Bases Classification and Theoretical backgrounds.

Non – aqueous solvents: Classification of solvents, properties of solvents (dielectric constant; donor and acceptor properties) protic solvents (anhydrous H_2SO_4, HF and glacial acetic acid), aprotic solvents (liquid SO_2, and N_2O_4). Solutions of metals in liquid ammonia, hydrated electron, Birch reduction. Complex hydrides aluminium, interhalogens, psuedo halogens, astatine.

Data analysis: Types of errors, propagation of errors, accuracy and precision, least sqares analysis, average standard deviation.

REFERENCES

1. Inorganic Chemistry (4th edition): J.E Huheey, E.A Keiter and R.L. Keiter (1993); Harper Collins.
2. Introduction to modern inorganic chemistry (4thedition): K.M. Mackay and R.A Mackay (1989): Blackie.
3. Advanced inorganic Chemistry (5th edition): F.A Cotton and G.Wilkinson (1990): Wiley.
4. Concise Inorganic Chemistry (5th edition): J.D. Lee (2000); Blackwell Science.
5. Concepts and Models if Inorganic Chemistry (3rd edition) B.E.Dougglas, D.H. Mc Daniel and Alexander. (2001): Wiley.
6. Chemistry of the Elements: Greenwood and Earnshaw. (1986): Pergamon Press.
7. Inorganic Chemistry (3rd edition): Shriver, Atkins and Langford (1999); Oxford University Press.

CPT – 1.2
Organic Reaction Mechanisms and Stereochemistry

UNIT – I 16 Hours

Structure and reactivity: Acids and Bases, Structural effects on acidity and basicity, hydrogen bonding, resonance, inductive and field effects, hyper conjugation effects, steric effect, Bredt's rule and Aromaticity.

Reaction Intermediates: Generation, structure, stability, reactivity and detection of classical and non-classical carbocations, carbanions, free radicals, carbenes, nitrenes and nitrogen, phosphorous and sulfur ylides. Nitrile oxides and nitrile imines. Singlet and triplet state oxygen-generation and reactions with organic molecules.

UNIT – II 16 Hours

Methods of Determining Reaction Mechanism: Kinetic and non-kinetic methods,

Kinetic method: Mechanistic implications from rate laws, the transition state theory, ambiguities in interpreting kinetic data, solvent effect, ionic effect, isotopic effect, substituent effect, steric effect, linear free energy relationships – Hammett equation and Taft treatment.

Non-kinetic methods: Energy profile diagram, identification of products, testing possible intermediates, trapping of intermediates, cross over experiments, isotopic labeling, stereochemical evidences.

UNIT – III 16 Hours

Reductions: Reduction of functional groups, catalytic reduction and hydrogen transfer reactions, Bakers yeast, $LiAlH_4$, $NaBH_4$, dissolving metal reactions (Birch reduction) diborane Meerwein-Pondorf-Varley reduction Wolf-Kishner Reduction, Clemensen reduction.

Oxidations: Oxidation with chromium and manganese compounds (CrO_3, $K_2Cr_2O_7$, PCC, PDC, Jones reagent, $KMnO_4$), peroxides and peracids, lead tetra acetate, periodic acid, SeO_2, NBS, Chloramine-T.

Reagents in Organic synthesis: use of following reagents in organic synthesis, Gilmann reagent, dicyclohexyl carbodiimide, DDQ, trimethylsilyl halides, diazomethane, LDA, 1,3-Dithiane, Woosdward and Prevost hydroxylation, Peterson reaction.

UNIT IV 16 Hours

Stereochemistry Optical Isomerism: Projection formulae, Fischer, Saw-horse, Newman and Fly wedge representations. Conformation and configuration of molecules, Optical properties of organic compounds, Elements of symmetry, Conditions for optical property, Absolute configuration(D,L), Cahn-Ingold-Prelog Rule and R,S systems. chirality, molecules with more than one chiral centre, threo and erythro isomers, methods of resolution, Optical activity in the absence of chiral carbon-biphenyls, allenes

and spiranes. Their R, S nomenclature.

Geometrical Isomerism: Cis-trans isomerism resulting from double bonds, monocyclic compounds & fused ring systems. E, Z-notations, Determination of configuration by physical and chemical methods.

Stereospecific and Stereoselective Synthesis: Regiospecific, Regioselective and Enantioselective synthesis, Cram's and Prelog's rules. Conformational analysis of acyclic, cycloalkanes and decalins. Effect of conformation on reactivity.

REFERENCES

1. E.L.Eliel and S.H. Wilen, Stereochemistry of Organic Compounds, JhonWilley and Sons, New York. 1994.
2. Introduction to stereo chemistry- K.Mislow.
3. Stereo chemistry and mechanism through solved problems – P.S. Kalsi.
4. D. Nasipuri, Stereo chemistry of Organic Compounds, 2nd edition, Wiley Eastern Limited, New Delhi, 1987.
5. H.Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mac Grow hill, New York, 1987.
6. Organic Chemistry – Morrison & Boyd.
7. I.L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
8. Basic principles of Organic Chemistry – Robert & Casereo.
9. N.S. Issacs, Reactive intermediates in Organic Chemistry, John Willey abd Sons, New York. 1974.
10. R.K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
11. E.S. Gould, Mechanism Mechanism and Structure in Organic Chemistry, Halt, Rinhart and Winston, New York, 964.
12. A guide book to mechanism in Organic Chemistry – Petersykes.
13. F.A Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
14. S.K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998.
15. Organic Chemistry-P.Y.Bruice (Pearson Education Pvt. Ltd.,New Delhi),2002.

CPT 1.3
Thermodynamics and Quantum Chemistry

UNIT – I 16 Hours

Concepts of entropy and free energy: Entropy as measure of unavailable energy. Entropy change during spontaneous process. Helmholtz and Gibbs free energies. Thermodynamic criteria of equilibrium and spontaneity. Variation of free energy with temperature and pressure. Maxwell's relations, Von't Hoff's reaction isotherm and isochore, Gibbs-Helmholtz equation. Determination of free energy changes. Nernst heat theorem and third law of thermodynamics-calculation of absolute entropies and residual entropy.

Partial molar Properties: Partial molar volumes and their determination by intercept method and from density measurements. Chemical potential and its significance. Variation of chemical potential with temperature and pressure. Formulation of the Gibbs Duhem equation. Thermodynamic derivation of the law of mass action mass action. Derivation of Duhem-Margules equation.

UNIT – II 16 Hours

Fugacity: Determination of fugacity of gases. Variation of fugacity with temperature and pressure. Activity and activity coefficients. Variation of activity with temperature and pressure. Determination of activity coefficients by vapour pressure, depression in freezing point, solubility measurements and by electrical methods.

Thermodynamics of dilute solutions: Raoult's law, Henry's law. Ideal and non-ideal solutions. Discussion and derivation of the laws of osmotic pressure, cryoscopy and ebullioscopy. Determination of molecular weights. Thermodynamic treatment using the concept of chemical potentials. Heat capacity of solids, Einstein and Debye heat capacity equations, Debye-characteristic temperature and its significance.

Phase Rule Studies: Thermodynamic derivation of phase rule, application of phase rule to the two component systems, simple eutectic type, compound formation with congruent melting point and incongruent melting points, systems involving the formation of a continuous series of solid solutions. Application of phase rule to three component systems. Systems of three liquids and systems of two salts and a liquid.

UNIT – III 16 Hours

Quantum Chemistry: Wave-particle duality, deBroglie equation. Heisenberg Uncertainty principle, concept of operators (operator-operand), algebra of operators, commutative and non-commutative operators, linear operator, Laplacian operator, Hamiltonian operator, eigen value, eigen function, class Q function, Hermitian operator, turn over rule, atomic units. Wave equation for stretched strings, Schrodinger wave equation for particles, postulates of quantum mechanics. Application of Schrodinger equation to a free particle and to a particle trapped in a potential field (one dimension and three dimensions). Degeneracy, wave equation for H atom, separation and solution of R, Ø and θ equations. Application of Schrodinger equation to rigid and harmonic

oscillator.

UNIT – IV **16 Hours**

Approximate methods – Necessity of approximate methods, perturbation method, the theory of perturbation method – first order and second order correction, application to He – atom (first order correction only) – calculation of first ionization potential and binding energy. Variation theorem-statement and proof. Application of variation theorem to a particle in one dimensional box, linear oscillator, H and He – atoms, SCF method for many electron atom. Slater Orbitals – Effective nuclear charge (ENC), expressions for slater orbitals for 1s, 2s, 3s, 2p and 3d electrons (no derivation). Slater's rules for calculation of ENC -Slater's orbitals for He, carbon and nitrogen. Theories of valence – introduction, linear and non-linear variation functions, secular equations, coulombic, exchange, normalization and overlap integrals, secular determinants.

REFERENCES

1. Thermodynamics for chemists by S. Glasstone. Affiliated East-West press, New Delhi, (1965)
2. Chemical Thermodynamics by I. M. Koltz, W.A Benzamin Inc. NewYork, Amsterdam, (1964).
3. Basic Physical Chemistry by W.J. Moore, Prentice Hall of India Pvt. Ltd., New Delhi (1986).
4. Text book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Lts., (II edition), (1974).
5. Quantum Chemistry - A. K. Chandra, Second Edition, Tata McGraw Hill Publishing Co. Ltd., (1983).
6. Quantum Chemistry – Eyring, Walter and Kimball, John Wiley and Sons, Inc., New York.
7. Quantum Chemistry – I.N. Levine, Pearson Education, New Delhi, (2000).
8. Theoretical Chemistry – S. Glasstone, East West Press,New Delhi,(1973).
9. Quantum Chemistry- R.J.Prasad, New Age International Publishers (1996).
10. Valence Theory – Tedder, Murel and Kettle.
11. Quantum Chemistry- D.A. McQuarrie.
12. Theoretical Inorganic Chemistry – Day and Selbin.
13. Elements of Physical Chemistry – Lewis and Glasstone.
14. Physical Chemistry by P.W. Atkins, ELBS,4th Edition,Oxford University Press (1990).

SPT-1.4.A
Organic Synthesis

UNIT – I 16 Hours

Reactions and Synthesis: Types of carbon to carbon bond forming reactions, Carbon skeletal complexity, stereoselectivity. Principles and methodology of alkylation, acylation, formylation, benzoylation, carbethoxylation, arylation, vinylation, methylenylation, O-alkylation versus C-alkylation. Methods of Carbon - Sulfur, Carbon - Nitrogen and Nitrogen - Nitrogen bond formations.

Protecting groups: Principle, Protection of Amide, Hydroxyl, Thiol, Amino, Carboxylic, Carbonyl, Phosphate and Terminal alkyne groups. Illustration of protection and deprotection in synthesis.

UNIT – II 16 Hours

Synthetic Design: Carbon skeleton frame work, Classification of carbon-carbon single bond and double bond forming reaction and their use in carbon skeleton ring formation. Ring closure and ring opening, Ring expansion and ring contraction reactions, use of Thorpe condensation, Carbene insertion reaction, Friedel-Crafts reaction.

Planning of organic synthesis: Selection of starting materials, Reagents and key intermediates during the synthesis. Functional group interconversion (FGI), Functional group addition (FGA), Target molecule (TM), Umpolung synthesis, Difference between conversion and synthesis.

UNIT – III 16 Hours

Disconnection Approach: General introduction to disconnection approach. Basic principles and technologies used in disconnection approach. Synthons and synthetic equivalents, one group C_X and two group C_X disconnections, 3-hydroxy-3-methylbutan-2-one, 2-methylbut-3-en-2-ol, (E)-pent-3-en-2-one. Cyclobutanone, 2-aminopropanoic acid, ethyl 4-amino-3-phenylbutanoate, ethyl 2,5-dimethylfuran-3-carboxylate, 4-(dimethylamino)butan-2-one, diethyl 3-methylcyclopent-3-ene-1,1-dicarboxylate, 5-((ethylperoxy)methyl)-2-phenyl-4H-pyran-4-one, imidazolidine-2,4-dione, 3,5-diphenylcyclopentane-1,2,4-trione, pyrimidine-2,4,6(1H,3H,5H)-trione, 2,3-dihydronaphthalene-1,4-dione, 4-(dichloromethyl)-4-methylcyclohexa-2,5-dienone, 2-oxocyclohexanecarbonitrile, ethyl 3-oxo-2-(3-oxobutanamido)butanoate, 1H-pyrrole-2-carbaldehyde, 3,4,8,8a-tetrahydronaphthalene-1,6(2H,7H)-dione, 5,6-dihydro-1H-indene-2,7(4H,7aH)-dione.

Retrosynthetic analysis: Retrosynthesis of Benzofurans, p-methoxy acetophenone, saccharein, α-bisabolene, nuciferal, penicillin-V. Analysis of alcohols, carbonyl compounds cyclic and acyclic alkanes, benzocaine, p-nitroacetophenone, acetonecyanohydrin, Synthesis of Cubane and Iswarane.

UNIT – IV **16 Hours**

Strategic Applications of Named Reactions in Organic Synthesis: Michael condensation, Clasien Ester condensation, Dels-Alder reaction, Cannizzaro reaction, Hydroboration reactions, Gabriel synthesis, Japp-Klingermann reaction, Kolbe-Schmitt reaction, Bachwald-Hartwig cross coupling reaction, Heck reaction, Suzuki coupling and Sonogashira coupling reactions.

REFERENCES:

1. Modern Organic Reactions- H.O.House.
2. Organic Synthesis- R.E.Ireland (Prentice Hall India), 1969.
3. Art in Organic Synthesis- Anand, Bindra & Ranganath-(Wiley New Delhi), 1970.
4. Organic Synthesis a Disconnection Approach- Stuart
5. Advanced Organic Chemistry-IV-Ed. Part A &B-F.J.Carrey & R.J.Sundberg(Kluwer) 2001.
6. Modern Methods of Organic Synthesis-N.Carruthers(Cambridge University), 1996.

SPT-1.4.B

Automated, Electro-analytical Methods and Separation Techniques

UNIT – I **16 Hours**

Automated systems: An Overview, definition, distinction between automatic and automated systems, advantages and disadvantages by automation, types of automated techniques. Non-discrete techniques, segmented flow methods and basic equipment, special techniques and devices, theoretical considerations and problems, applications. Single/channel and multi channel auto analysers, BUN analysers, automatic glucose analyser and ammonia in water analyser, COD analyser, CFA in industry. Non-segmented flow methods.

Flow injection analysis, principles, types of dispersion, factors affecting dispersion, applications of small, medium and large dispersions, stopped flow methods, flow injection titrations. Discrete methods: Centrifugal fast scan analyser, automatic multipurpose analysers, automatic elemental analyser, automatic analyser based on multilayer film-principles, film structure, instrumentation applications.

Comparison of discrete and non-discrete methods. Advantages of flow injection measurements over continuous flow measurements.

UNIT – II **16 Hours**

Redox titrations: Balancing redox reactions, calculation of the equilibrium constant of the reaction, titration curves, visual end point detection. Redox indicators- theory, working and choice. Applications of redox titrations. Sample prearation - prereduction and preoxidation.

Electroanalytical methods: Introduction to electro analytical methods.

Potentiometry: Fundamentals of potentiometry. Indictor and ion-selective electrodes. Membrane electrodes. Glass electrode for pH measurement, glass electrodes for cations other than protons. Liquid membrane electrodes, solid state ion selective detectors and biochemical electrodes. Potentiometric end point detection. Applications of potentiometry. Direct potentiometric measurements-determination of pH and fluoride.

Electrogravimetric analysis: Theory, apparatus, cell process, deposition and separation, electrolytic separation of metals, applications.

Voltammetry and Polarography: Theory of classical polarography, polarographic measurements, polarograms, polarographic currents. Current and concentration relationship. Factors influencing diffusion currents, half-wave potential, oxygen interference, advantages and limitations.

Modified voltammetric methods, pulse polarography, fast linear-seep polarography, first order polarographic techniques. Organic polarography.

Cyclic voltammetry: Principles and applications.

Stripping analysis: Stripping voltammetry-basic principles, electrodes used for stripping analysis, apparatus for stripping analysis, applications, determination of lead in water voltammetry with micro electrodes.

UNIT – III **16 Hours**

Fundamentals of chromatography: general description, definition, terms and parameter used in chromatography, classification of chromatographic methods, criteria for selection of stationary phase, and mobile phase, nature of adsorbents, factor influencing the adsorbent, nature and type of mobile phases and stationary phases.

Theories- plate theory, rate theory, brad broadening-eddy diffusion, longitudinal diffusion and resistance to mass transfer, column efficiency-plate theory and rate theory approach, Van Deemter's equation, and its modern version, optimization column performance, interrelationships- capacity factor, selectivity factor, column resolution, distribution constant and applications of conventional column chromatography, advantages and limitations.

Thin- layer chromatography (TLC): definitions, mechanism, efficiency of TL plates, methodology-selection of stationary phase, and mobile phase, preparation of plates, spotting, development, identification and detection, reproducibility of RF values, comparison of TLC with high performance thin- layer chromatography, Paper chromatography, and column chromatography. Qualitative and quantitative analysis.

. **UNIT – IV** **16 Hours**

Gas chromatography (GC): principle, comparison of GSC and GLC, instrumentation column packed and tubular, study of detector- thermal conductivity, flame ionization, electron capture and mass spectrometry, factors affecting separation, applications.

High Performance Liquid Chromatography (HPLC): apparatus, pump, column packing, characteristics of liquid chromatographic detector-UV, IR, refractometer and fluorescence detector, advantages and applications.

Ion-exchange chromatography (IEC): definitions, requirement of ion-exchange resin, synthesis and type of ion exchange resin, principle, basic features of ion exchange reactions, resin properties-ion- exchange capacity, resin selectivity factors affecting the selectivity, applications of IEC in preparative, purification and recovery processes.

Exclusion chromatography: theory and principle in size Exclusion chromatography, experimental techniques for gel-filtration chromatography (GFC) and gel-permeation chromatography (GPC), materials for packing – factors governing column efficiency, methodology, applications.

REFERENCES:

1. Fundamental Analytical Chemistry, D.A. Skoog, D.M. West, Hollar and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G. D. Christian, 5th ed., 2001 John Wiley and Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993 presence Hall, Inc. New Delhi.
4. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D Barners and M.J.K. Thomas, 6th edition, Third Indian Reprint. 2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, Callifornia, 1990.

CPP 1.5 (1.1)

Practical Inorganic Chemistry - 1

64 Hours

1. **Analysis of Ores:**
   1. Hematite
   1. Insoluble (gravimetrically)
   2. Iron titrimetrically using cerium (IV) solution.
   2. Dolomite.
   1. Insoluble (gravimetrically)
   2. Calcium and magnesium using EDTA
   3. Pyrolusite.
   1. Insoluble (gravimetrically)
   2. Manganese dioxide titrimetrically using permanganate.

2. **Micro – volumetric estimation of calcium using EDTA.**

3. **Analysis of alloys:**
   a) Solder – lead and tin using EDTA
   b) Copper – nickel alloy
   (i) Copper volumetrically using KIO_3
   (ii) Nickel gravimetrically using DMG.

4. **Quantitative analysis of mixtures:**
   a) Chloride and iodide
      (i) Iodide volumetrically using KIO_3
      (ii) Total halide gravimetrically.
   (b) Calcium and lead – using EDTA

5. **Spectrophotometric determination of :**
   a) Iron using thiocyanate / 1, 10 – phenonthroline
   b) Chromium using diphenyl carbazide.
   c) nickel Using dimethylglyoxime
   d) Titanium using hydrogen peroxide.

6. **Circular paper chromatography – separation of : (Demonstration)**
   a) Iron and nickel,
   b) Copper and nickel.

REFERENCES

1. A text book of Quantitative Inorganic Analysis – A.I. Vogel. III edition.
2. Vogel's text book of Quantitative Chemical Analysis – J. Basset, R.C. Denney.
3. G.H. Jeffery and J. Mendham. Spectrophotometric determination of elements.

CPP-1.6 (1.2)
Practical Organic Chemistry-1

64 Hours

Organic Preparations: Preparations involving oxidation, reduction, dehydration, decarboxylation, halogenation, nitration, sulfonation, diazotization, cyclization, condensation, addition reactions.

Emphasis has to be given for collecting the literature, setting up of experiment, purification and characterization of the final product based on physical data, mechanism involved in the reaction, calculation of theoretical yield, practical yield and percentage yield.

1. Preparation of p-bromoaniline from acetanilide.
2. Preparation of p-nitroacetanilide from acetanilide.
3. Preparation of n-butyl bromide from n-butanol.
4. Preparation of o- iodobenzoic acid from anthranilic acid.
5. Preparation of aniline from nitrobenzene.
6. Preparation of osazone derivative.
7. Preparation of penta – O – acetyl – D – glucose from glucose.
8. Preparation of 3 – methyl – 1 – phenyl – pyrazolone.
9. Preparation of cis and trans cinnamic acids.
10. Preparation of phenoxy acetic acid.
11. Preparation of hippuric acid from glycine.
12. Preparation of m-nitrobenoic acid from methyl benzonate.
13. Preparation of aspirin.
14. Oxidation of toluene by $KMnO_4$
15. Preparation of adipic acid from cyclohexanol.

REFERENCES:

1. A Text book of Practical Organic chemistry – A.I. Vogel Vol. I
2. Practical Organic chemistry – Mann & Saunders.
3. Manual of Organic chemistry – Dey and Seetharaman.
4. An introduction to practical organic chemistry – Robert, Vingrover etc.
5. J.N Guthru and R. Kapoor, Advance experimental chemistry. S. Chand company, 1991.
6. R. K. Bansal, Laboratory Manual of Organic chemistry, New PGE ingternational (P) ltd. London, 3rd edition, 1996.
7. N. K. Visno, Practical Organic Chemistry, New PGE International (P) Ltd. London, 3rd edition, 1996.

CPP 1.7 (1.3)

Practical Physical Chemistry – 1

64 Hours

1. Study of phase diagram of a three component system (Eg: acetic acid-chloroform-water and benzene-alcohol-water system).
2. Determination of molecular weight of a compound using Bekmann's cryoscopic method using benzene or / and water as solvent.
3. Determine the molecular weight of benzoic acid in benzene and find the degree of association.
4. Determine the activity coefficient of an electrolyte by freeing point depression method.
5. To determine the eutectic point of a two component system (Naphthalene-m-dinitrobenzene, Naphthalene-biphenyl system, naphthalene - phenantherene and benzophenone-diphenyl amine).
6. Determine the transition temperature of Glauber's salt ($Na_2SO_410H_2O$) by solubility method.
7. To determine the partial molal volumes of sodium chlorides in aqueous solutions
8. To determine the relative viscosity coefficient of dilute solutions of sodium chloride at different concentrations
9. To determine the degree of ionization of sodium chloride at different concentrations of its aqueous solutions from the depression of freezing point temperatures
10. To determine the dimerization constant of benzoic acid in benzene medium by partition method
11. Determine the partial molar volume of methanol in dilute aqueous solutions.
12. Determination of molecular weight of non-volatile and nonelectrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
13. Determination of glass transition temperature of a given salt (e.g., $CaCl_2$) conductometrically.

REFERENCE:

1. Practical Physical chemistry – A.J. Findlay.
2. Experimental Physical Chemistry – F. Daniels et al.
3. Selected Experiments in Physical Chemistry – Latham.
4. Experiments in Physical Chemistry – James and Prichard.
5. Experiments in Physical Chemistry – Shoemaker.
6. Advanced Physico – Chemical experiments – J. Rose.
7. Practical Physical Chemistry. - S.R. Palit.
8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.
10. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994)
11. Experimental physical chemistry, R. C. Das and B. Behera, Tata McGraw-Hill Publishing Company Limited, 1983.
12. Experimental Physical Chemistry, V. D. Athawale and Parul Mathur, New Age International (p) Limited, Publishers, New Delhi, 2001.

SPP- 1.8 (1.4.A)
Practical Organic Chemistry

64 Hours

Emphasis has to be given in designing the procedure based and the literature available, setting up of experiment, purification and characterization of the final product based on physical data, mechanism involved in the reaction, calculation of theoretical yield, practical yield and percentage yield.

Multi Step Organic Synthesis

1. Preparation of Ethyl resorcinol from Resorcinol,
2. Preparation of 3-Bromo-4-methyl benzaldehyde from p-Toludine,
3. Preparation of ε-Caprolactam from cyclohexanone,
4. Preparation of p-Amionobenzoic acid from p-Nitrotoludine,
5. Preparation of s-Tribromobenzene from aniline,
6. Preparation of o-hydroxy acetophenone from phenol,
7. Preparation of Benzanilide from Benzophenone,
8. Preparation of Benzylic acid from Benzoin,
9. Preparation of Benzopinacolone from Benzophenone,
10. Preparation of p-Chlorotoluine from p-Toludine,
11. Preparation of 2,5-Dihydroxy acetophenone from Hydroquinone.

REFERENCES:

1. An introduction to practical organic chemistry- Robert, Vingrove etc
2. Semimicro qualitative analysis by Cheronis, Entrikin and Hodnet.
3. R. K. Bansal. Laboratory Manual of Organic Chemistry, New PAG International (P) Ltd. London, 3rd edition, 1966
4. N. K. Visno, Practical Organic chemistry, New PAGE International (P) (P) Ltd. London, 3rd edition, 1966
5. Quantitative Analysis By A I Vogel
6. Practical organic Chemistry, Mann and Saunders

SPP- 1.8 (1.4.B)

Practical Analytical Methods

64 Hours

1. Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium (IV) sulphate.
2. Determination of iron in razor blade by visual and potentiometric titration using sodium metavanadate.
3. Potentiometric determination of the equivalent weight and Ka for a pure unknown weak acid.
4. Potentiometric titrations of copper with EDTA.
5. Determination of calcium in limestone by redox titrations.
6. Determination of copper in an ore/an alloy by iodometric redox titration.
7. Determination of antimony in stibnite by titration with iodine.
8. Analysis of commercial hypochlorite or peroxide solution by iodometric titration.
9. Periodate determination of ethylene glycol (Malprade reaction).
10. Determination of silver in an alloy by Volhard method.
11. Determination of vitamin C in citrus fruit juice by iodimetric titration.
12. Determination of ascorbic acid in vitamin C tablet by titrations with $KBrO_3$.
13. Electrolytic determination of copper in an ore/an alloy.
14. Analysis of waste waters for DO and COD by redox titrimetry
15. Polarographic determination of copper and zinc in brass.

REFERENCES

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D Christian, 5th edition, 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A Day and A.L. Underwood, 6th edition, 1993prentice Hall, Inc. New Delhi.
4. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham, R.C Denney, J.D Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principals, John H. Kennedy, 2nd edition, Saunders College Publishing California, 1990.

CPT – 2.1
Group Theory & Coordination Chemistry

UNIT – I 16 Hours

Symmetry elements and symmetry operations: rotation axis, rules for orientation of molecules, plane of symmetry, rotation-reflection axis, center of symmetry and identity element of symmetry. Correlation of Schoenflies and Hermann- Maugin Symbols for symmetry elements. Products of symmetry operations. General relations among symmetry elements and symmetry operations.

Group theory: Concept of a group, definition of a point group, procedure for classification of molecules into point groups. Schoenflies and Hermann - Maugin symbols for point groups. Properties and definitions of group theory. Multiplication tables for the symmetry operations of simple molecules. International (Hermann - Mauguin) notations, subgroups. Matrix notation for the symmetry elements and for geometric transformations. Class of a group and similarity transformation.

UNIT – II 16 Hours

Representation of groups: Reducible and irreducible representations. The great orthogonality theorem and its consequences. Character tables (C_s, C_i, C_2, C_{2v}, C_{2h}, D_{3h} and C_{3V}, T_d). Labelling of irreducible representations. Group theory and hybrid orbitals to form bonds.

Molecular vibrations: Introduction, symmetry of normal vibrations, determining the symmetry types of normal modes, selection rules for fundamental vibration transitions.

Representation of vibrational modes in non-linear molecules. Group theory and linear molecules (integration method). Vibrations in polyatomic molecules.

Applications of group theory: Applications of group theory to crystal field theory. Bonding in octahedral and tetrahedral complexes. Symmetry and dipole moments, symmetry and optical activity.

UNIT – III 16 Hours

Coordination compounds: Introduction, preparative methods- simple addition reactions, substitution reactions, oxidation-reduction reactions, thermal dissociation reactions, reactions of coordinated ligands, trans effect, other methods. Geometries of metal complexes of higher coordination numbers (2-12).

Stability of coordination compounds: Introduction, Stepwise and overall stability constants of coordination compounds, factors influencing the stability of metal complexes with reference to the nature of metal ion and ligand, the Irving-William series, chelate effect.

Theoretical aspects of the determination of stability constants of the coordination compounds by spectrophotometric, pH metric and polarographic methods.

Crystal Field Theory: Salient features of CFT, d-orbital splitting in octahedral, tetrahedral, square planar and tetragonal complexes, measurement of 10Dq. Spectrochemical series, short comings of CFT.

UNIT – IV **16 Hours**

Experimental evidences for covalence and adjusted CFT. MOT applied to octahedral, tetrahedral and square planar complexes without and with pi-bonding. M.O. energy level diagrams for octahedral complexes with sigma-ligands having pi-systems. Jahn-Teller effect.

Electronic absorption spectra of transition metal complexes: Introduction, selection rules, electronic –dipole transitions, magnetic-dipole transitions, term symbol for d^n ions. Effects of spin orbit coupling, energy level diagrams, Orgel, Correlation and Tanabe-Sugano diagrams, charge-transfer transitions.

Magnetic properties of transition metal complexes: Introduction, magnetic susceptibility and its measurements, spin cross over systems, ferromagnetism and antiferromagnetism.

REFERENCES

1. Symmetry in Chemistry – H. Jaffe and M.Orchin,John Wiles, New York(1965).
2. Symmetry in Molecules- J.M.Hollas, Chapman and Hall Ltd., London (1972).
3. Chemical Applications of Group Theory- F.A. Cotton, Wiley Eastern Ltd., nd edition,New Delhi (1971).
4. Group theory and Symmetry in Chemistry- G. Raj, A. Bhagi and V. Jain, Krishna Prakashan Media (P) Ltd., Meerut (1998).
5. The Determination of Molecular Structure – P.J. Wheatley, Oxford University Press, Oxford (1969).
6. Advanced inorganic chemistry, (5^{th} edition)- F.A. Cotton and G. Wilkinson: John Wiley and sons 1988.
7. Inorganic chemistry (3^{rd} edition)-J.E. Huheey: Harper and Row, N.Y. 1983
8. Modern aspects of Inorganic chemistry (4^{th} edition)-H.J., Emeleus and A.G. Sharpe: UBS 1989.
9. Coordination chemistry-S.F.A. Kettle, (1969)-Thomas Nelson and Sons Ltd., London.
10. Physical Inorganic Chemistry-A Coordination Chemistry Approach- S.F.A. Kettle, Spektrum, Oxford, 1996.
11. Symmetry and spectroscopy of molecules, K. Veera Reddy, New-Age International, 2009.
12. Group theory and its chemical applications, P. K. Bhattacharya, Himalaya Publishers, Students Edition.

CPT – 2.2
Reaction Mechanism, Photochemistry and Spectroscopy

UNIT – I 16 Hours

Mechanism of Addition reactions: Addition to C-C multiple bonds involving electrophiles, nucleophiles and free radicals. Electrophilic addition, Nucleophilic addition, addition of hydrogen halides, oxymercuration and demurcuration. Epoxidation of alkenes, addition to rigid bicyclic alkenes.Hydroboration and its application.

Addition to Carbon-Hetero Multiple Bonds: Electrophilic, nucleophilic and free radical additions to C=O and C=N systems.

Elimination reactions: Mechanism and stereochemistry of eliminations- E1, E2, E1cb mechanism, cis – elimination, Hoffmann and Saytzeff eliminations, competition between elimination and substitution, Chugaev reaction.

UNIT – II 16 Hours

Stereochemistry of nucleophilic substitution reactions, allylic nucleophilic substitution reactions, neighboring group participation and anchimeric assistance. Factors influencing the rates of nucleophilic substitution reactions.

Mechanisms of aromatic nucleophilic substitution reactions- SNAr, SNi & benzyne mechanism, Bucherer reaction.

Electrophilic Substitution Reactions: Bimolecular mechanisms-SE1, SE2 and SEi mechanism. Electrophilic substitution reactions accompanied by double bond shifts. Mechanism of aromatic electrophilic substitution reactions, Arenium ion mechanism, orientation and reactivity, energy profile diagram. The ortho/para ratio, ipso attack, orientation in other ring systems. Mechanism of nitration, halogenation, sulphonation, Mannich reaction, chloromethylation, Mechanism of Vilsmeir-Haack reaction, Pechmann reaction and Fries rearrangement.

UNIT – II 16 Hours

Photochemistry and concerted reactions: Introduction, light absorption and electronic transitions, Jablonski diagram, intersystem crossing, energy transfer, sensitizers, quenchers

Photochemistry of olefins, conjugated dienes, aromatic compounds, ketones, enones, photooxidations, photoreductions Norrish type I and II reactions, Paterno-Buchi reaction, Barton reaction, Di-pi-methane rearrangements

Pericyclic reactions: Electrocyclic reactions: Stereochemistry, Symmetry and Woodward-Hofmann rules for electro cyclic reactions, FMO theory of electrocyclic reactions, correlation diagram for cyclobutadine and cyclohexadiene systems.

Cycloaddition reactions: [2+2] [3+2] and [4+2] cycloadditions, analysis by FMO and

correlation diagram method. Sigmatropic reactions: Classification, stereochemistry and mechanisms.

UNIT – IV **16 Hours**

Nuclear Magnetic Resonance Spectroscopy: General introduction. Theory of magnetic resonance-magnetic properties of nuclei, spin number and allowed transitions-classical description. Population of nuclear magnetic energy levels-relaxation process-factors affecting line width. Magnetic shielding–chemical shift- standards employed –shielding mechanism- chemical shift correlations. Spin-spin interaction-coupling constants and factor influencing the coupling constant- splitting patterns- first order and second order rules for predicting the band multiplets.

Proton decoupling- Broad band decoupling- Off resonance decoupling, pulse decoupling and nuclear Overhauser enhancement. Fourier transform NMR – time domain and frequency domain. Studies of nuclei other than protons ^{13}C, ^{19}F, ^{14}N and ^{31}P.

Mass Spectroscopy: Principle, instrumentation, different methods of ionization. Mass spectra – molecular ion, base peak, meta-stable peak. General rules for fragmentation patron hydrogen transfer rearrangement and McLafferty rearrangement. Applications: Identification of compounds, structural information from fragmentation patterns.

REFERENCES

1. H. Pine, Hendickson, Cram and Hammond, Organic Chemistry, Mac Grow Hill, New York, 1987.
2. Organic Chemistry-Morrison & Boyd
3. I. Finar, Organic Chemistry, ELBS Longmann, Vol I &II, 1984.
4. J. March, Advanced Organic Chemistry, Willey Interscience, 1994.
5. E.S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart &Winston, Nee York, 1964.
6. F. A. Carey and Sundberg, Advanced Organic Chemistry-Part A and B, 3rd edition, Plenum Press, New York, 1990.
7. Comprehensive Organic Synthesis- B. M. Trost and I. Fleming series, Pergamon Press, New York, 1991.
8. A Guide book to mechanism in Organic Chemistry- Peterskye
9. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd., 1998.
10. Photochemistry-Calvert & Pitts, Willey, New York, (1966).
11. Advances in Photochemistry- Rahatgi Mukherjee.
12. Principles and applications of Photochemistry – RP Wayne, Elsevier, New York, (1970).
13. Photochemistry, Paul Suppan, RSC, London, (1944).
14. Dupey and Chapmann Molecular reactions and Photochemistry, Prenctic Hall-International, Tokyo, 1972.
15. J. Michael Hollas , Fourth Edition, Modern Spectroscopy, Wiley, 2004.
16. J. E. Sansonetti and W. C. Martin, Handbook of Basic Atomic Spectroscopic Data, 2007.
17. Martin Kaupp, Michael Bhl, Vladimir G. Malkin, Calculation of NMR and EPR Parameters-Theory and Applications, 2004.
18. Pavia, Lampman, Kriz. Introduction to Spectroscopy. 2001.

SPT 2.3 A
Statistical Mechanics, Electrochemistry and Spectroscopy

UNIT – I 16 Hours

Statistical mechanics: Introduction, thermodynamic probability relation between entropy and thermodynamic probability, principle of equipartition of energy, Maxwell-Boltzmann distribution equation, partition function, translational rotational and vibrational partition functions, evaluation of molecular entropies, entropy of monatomic gas (Sackur-Tetrode equation). Evaluation of internal energy, enthalpy, Helmholtz and Gibbs free energies, equilibrium constant, partition functions of atoms and diatomic molecules.

Distribution equations – Bose-Einstein and Fermi-Dirac distribution equations. Free energy function and its use in evaluating the equilibrium constant, entropy of water and hydrogen.

UNIT – II 16 Hours

Poisson–Boltzmann equation; ion–cloud and chemical potential change; Electrical double layer and its thermodynamics.

A brief survey of Helmholtz - Perrin, Gouy - Champman and Stern electrical double layer, EMF cells Liquid Junction Potential and its determination. Debye-Huckel theory of strong electrolytes, Debye Huckel – Onsager equation, Debye - Huckel limiting equation for activity coefficients, modifications and verifications. Diffusion - Fick's law of diffusion - Effect of ionic association on conductance-electro kinetic phenomena - membrane potential.

Transport Number: Determination of transport number by Hittorf method and e.m.f method. True and apparent transport numbers. Abnormal transport numbers, effect of temperature and concentration on transport number. Energetics of cell reactions, effect of temperature, pressure and concentration on energetics of cell reactions (calculation of ΔG, ΔH and ΔS).

Electrodics: The basic electrodic equation: Butler–Volmer equation; overpotential; polarizable and nonpolarizable interfaces.

UNIT – III 16 Hours

Electrochemical power sources - theoretical background on the basis of thermodynamic and kinetic considerations.

Primary cells - various types, especially magnesium and aluminium based cells - magnesium reserve batteries.

Properties of Electrochemical energy storers: Measure of battery performance, Charging and discharging of a battery, Storage Density, Energy Density. Classical Batteries : (i) Lead Acid (ii) Nickel-Cadmium, (iii) Zinc manganese dioxide. Modern

Batteries : (i) Zinc-Air (ii) Nickel-Metal Hydride, (iii) Lithium Battery.

Fuel cells - classification - chemistry of fuel cells - detailed description of hydrogen/oxygen fuel cells, alkaline fuel cell, Phosphoric and fuel cell, methanol - molten carbonate solid polymer electrolyte and applications of fuel cells

Solar energy conversion devices - photovoltaic cells - photoelectrochemical cells - semiconductor electrolyte junctions, photocatalytic modes for fuel conversion process - photobiochemical options.

Corrosion and prevention: Thermodynamics and the stability of metals, Potential -pH (or Pourbaix) Diagrams; uses and abuses, Corrosion current and corrosion potential - Evans diagrams. Measurement of corrosion rate: i) Weight Loss method, (ii) Electrochemical Method. Inhibiting Corrosion: Cathodic and Anodic Protection. (i) Inhibition by addition of substrates to the electrolyte environment, (ii) by charging the corroding method from external source, anodic Protection, Organic inhibitors, Passivation :Structure of Passivation films, Mechanism of Passivation.

UNIT – IV **16 Hours**

Microwave spectroscopy: classification of the molecules based on rotation-Linear, symmetric, spherical and asymmetric top molecules Pure rotation Spectra of diatomic molecules-Rigid rotor model, energy levels, rotational quantum number and the selection rule. Effect of non rigid rotation. Determination of moment of inertia and bond length of diatomic molecules using rotational spectra. Effect of isotopic substitution on rotation spectra. Relative intensities of spectral lines. Rotational spectra of polyatomic molecules (BCl_3, OCS and CH_3F). Moment of inertia expression for linear and nonlinear molecules. Experimental techniques – Microwave spectrometer. Applications-Principles of determination of bond length and Moment of inertia from Rotational spectra. Stark effect in rotation spectra and determination of dipole moments.

Vibrational spectroscopy: Vibration of diatomic molecules, the energy curves for simple harmonic oscillator- vibration spectra. Effects of anharmonic oscillation- the diatomic vibrating rotator – vibration rotation spectra of carbon monoxide. Expressions for fundamental and overtone frequencies.

Vibration of polyatomic molecules- The number of degrees of freedom of vibration and their symmetry – overtones and combination frequencies – Influence of rotation on the spectra. Parallel and perpendicular vibrations (CO_2 and H_2O). Fundamental, overtone, combination and difference bands. Fermi resonance. Force constant , its determination and significance. The theory of infrared absorption and theoretical group frequency. Intensity of absorption band and types of absorptions. Correlation chart. Important spectral regions- Hydrogen stretching region, triple bond region, double bond region and 'fingerprint region'. Application: Structure of small molecules: XY_2- linear or bent, XY_3: planer or pyramidal. Coordination chemistry (aqua, amino, nitrite, thiocyanate) - change in symmetry on coordination (nitrate, carbonate and sulphate complexes)- Organometallic compounds- geometrical isomers and Jahn-teller Effect. Organic compounds- Structure determination and the characteristic group frequencies.

REFERENCES

1. Statistical thermodynamics by B.C. Meclelland, Chapman and Hall, London (1973).
2. Elementary Statistical thermodynamics by N. D. Smith, plenum Press, NY (1982).
3. Elements of classical and statistical thermodynamics by L.K Nash, Addison-Westley (1970).
4. Statistical thermodynamics by I. M. Klotz.
5. Introduction to Statistical thermodynamics by M. Dole, Prentice-Hull, (1962). Elements of Physical Chemistry – Lewis and Glass tone.
6. Physical Chemistry by P.W. Atkins, ELBS,4th Edition, Oxford University Press (1990).
7. Introduction to electrochemistry by S. Glasstone.
8. Modern Electrochemistry Vol I and II by J.O.M. Bockr's and A.K.N. Reddy, Plenum Press, New York (1970).
9. Chemical and Electrochemical energy systems – R.NarayanandB. Vishwanathan, Universities Press (India) (1998).
10. Electrochemistry – Principles and applications by E.G. Potter.
11. Electrochemistry by Reiger, Prince Hall (1987).
12. C. A. Vincent Modern Batteries, Edward Arnold, 1984.
13. R. Narayanan and B. Viswanathan, Chemical and Electrochemical energy systems, Orient Longmans, 1997.
14. A. S. J. Appleby and F. K. Foulkes, Fuel cell Hand Book, Von Nostrand Reinhold, 1989.
15. D. Linden, Hand book of batteries and Fuel cells, McGraw Hill Book Company, 1984.
16. T. Ohta, Solar Hydrogen energy systems, Pergamon Press, 1979.
17. M. Gratzel, Energy Resources through photochemistry and catalysis, Academic Press, 1983.
18. T. Ohta, Energy Technology, Sources, Systems and Frontiers conversions, Pergamon, 1994.
19. Fundamentals of molecular spectroscopy by C.N Banwell and E.M. Mc Cash-4th edition, Tata Mc. Graw Hill, New Delhi, 1998.
20. Introduction to molecular spectroscopy by G. M. Barrow, Mc Graw Hill, New York (International student edition) (1972).
21. Theoretical chemistry by S. Glasstone, affiliated East-West press Pvt. Ltd., New Delhi, (1973).
22. Spectroscopy Vol I and II by B. P. Straughan and S. Walker, John wiley and sons Inc, New York. (1976).
23. Vibrational spectroscopy, Theory and Applications, by D. N. Sathyanarayana, New Age International Publications, new Delhi, (1996).
24. Instrumental methods of analysis by H.H Willard, L.L. Merritt and J.A Dean, 7th edition, (1988).
25. Physical methods inorganic chemistry by R.S Drago, Affliated East-West Press Pvt. Ltd. (student edition) (1978).
26. Principles of instrumental Analysis by D A. Skoog, F J. Holler and T.A. Nieman. Fifth edition, Saunders college Publishing, Philadelphia.
27. Spectroscopy of organic compounds, P. S. Kalsi, new age international publishers, new Delhi.

SPT 2.3.B

Surface, Nuclear Chemistry and Non-Equilibrium Thermodynamics

UNIT – I 16 Hours

Macromolecules: Number and average molecular mass, molecular mass determination: Osmometry, Viscometry, sedimentation, diffusion and light scattering method.

Chemical adsorption, application of adsorption, factors affecting adsorption, Langmuir theory, BET theory, heat and entropy of adsorption. Surface film on liquids; Electro-kinetic phenomena. types of adsorption isotherm. micelle formation, mass action model and phase separation model, shape and structure of micelles, CMC, factors affecting CMC effect of added electrolyte on the surface excess of ionic surfactants.

Modern techniques for investigating surfaces-Low energy electron diffraction(LEED), PES, Scanning tunneling and atomic force microscopy (STM and AFM).

UNIT – II 16 Hours

Electrode Interfaces: Quantum aspects of charge transfer at electrode-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces: Theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces, effect of light at semiconductor solution interface.

Electro catalysis: Comparison of electro catalytic activity, importance of oxygen reduction and hydrogen evolution reactions, and their mechanism,

Bio-electrochemistry: Threshold membrane phenomena, Nernst Plank equation, Hodges Huxley equations, core conductor models, electrocardiography.

UNIT – III 16 Hours

Nuclear Chemistry: Radioactive decay and equilibrium, Nuclear reactions; Q-value, cross sections, types of reactions, chemical effects of nuclear transformations, fission and fusion, fission products and fission yields. Radioactive techniques, tracer technique, neutron activation analysis, counting techniques such as G.M. ionization and proportional counter.

UNIT – IV 16 Hours

Non-equilibrium thermodynamics: Phenomenological laws and Onsager's reciprocal relations, Linear phenomenological relations, Conjuagate flows, Entropy production, Specific examples of entropy production, Interanal energy, Prigogine's principles of minimum entropy production, Entropy production in coupled phenomena, Seebeck effect, Peltier effect, Second Kelvin relation, First Kelvin relation.

REFERENCES:

1. Y. Moroi, Micelles : Theoretical and Applied Aspects, Plenum Press, New York (1992).
2. E.M. Mc Cash, Surface Chemistry, Oxford University Press, Oxford (2001).
3. P.A. Eglestaff," An Introduction to Liquid State" Academic Press.
4. J.A.Pryde,"The Liquid State"
5. A.F.M.Barton, "The Dynamics of Liquid State", Longman.
6. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
7. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
8. G. Hughes- Radiation Chemistry- Oxford University Press, London
9. A. D. Baker and C. R. Brundle, Eds, Electron Spectroscopy, Vol. 1 - 4 Academic Press, 1978.
10. H. Ibach, Electron Energy Loss Spectroscopy, Springer Verlag, 1992.
11. D. Briggs and M. P. Seah, Editors, Practical Surface Analysis, 2nd ed. vols 1 & 2, Auger and X-ray photoelectron spectroscopy, John Wiley & Sons, 1990.
12. Principles of Physical Chemistry, Puri, Sharma and Pathania, S-C Chand and Co, New Delhi

OET-2.4

Fundamentals of Chemical Analysis & Chromatography

UNIT – I **16 Hours**

Statistical Treatment of Analytical Data and Sampling: Limitations of analytical methods. Classification of errors – systematic errors – sources, effects and their reduction. Random errors – sources and distribution. Accuracy and precision. Measures of central tendency and variability. Reliability of results – confidence interval.

Comparison of results – Student's t-test, comparing the two means and standard deviations-F test, t-test and paired t-test. Rejection of a result – Q-test. Number of replicate determinations. Control charts. Correlation and regression- correlation coefficient, linear regression, errors in slope and intercept, error in the estimate of concentration. Detection limits.

Sampling and sample handling – representative sample, sample storage, sample pretreatment and sample preparation. Hazards in sampling.

Quality in analytical laboratories – quality control and quality assurance, accreditation system.

UNIT – II **16 Hours**

Acid base titrations: Principles of titrimetric analysis, titration curves for strong acid-strong base, weak acid-strong base and weak base-strong acid titrations, poly protic acids, poly equivalent bases, determining the equivalence point – theory of acid base indicators, colour change range of indicator, selection of proper indicator.

Applications of acid-base titrations: Determination of nitrogen, sulphur, ammonium salts, nitrates and nitrites, carbonates and bicarbonates, and organic functional groups like carboxylic acid, sulphonic acid, amine, ester, hydroxyl, carbonyl groups, air pollutants like SO_2.

Acid-base titrations in non-aqueous solvents: Role of solvent in Acid-base titrations, solvent systems, differentiating ability of a solvent, some selected solvents, titrants and standards, titration curves, effect of water, determining the equivalence point, typical applications-determination of carboxylic acids, phenols and amines.

UNIT – III **16 Hours**

Precipitation titrations: Titration curves, feasibility of precipitation titrations, factors affecting shape – titrant and analyte concentration, completeness of the reaction, titrants and standards, indicators for precipitation titrations involving silver nitrate the Volhard, the Mohr and Fajan's methods, typical applications.

Complexometric titrations: Complex formation reactions, stability of complexes, stepwise formation constants, chelating agents, EDTA – acidic properties, complexes with metal ions, equilibrium calculations involving EDTA, conditional formation constants, derivation of EDTA titration curves –effect of other complexing agents,

factors affecting the shape of titration curves- completeness of reaction, indicators for EDTA titrations- theory of common indicators.

UNIT – IV **16 Hours**

Solvent extraction: definition, types, principle and efficiency of extraction, sequence of extraction process, factor affecting extraction-pH, oxidation state, modifiers, synergistic, masking and salting out agent, techniques- batch and continuous extraction, application.

Fundamentals of chromatography: general description, definition, terms and parameter used in chromatography, classification of chromatographic methods, criteria for selection of stationary phase, and mobile phase, nature of adsorbents, factor influencing the adsorbent, nature and type of mobile phases and stationary phases.

Theories- plate theory, rate theory, brad broadening-eddy diffusion, longitudinal diffusion and resistance to mass transfer, column efficiency-plate theory and rate theory approach, Van Deemter's equation, and its modern version, optimization column performance, interrelationships- capacity factor, selectivity factor, column resolution, distribution constant and applications of conventional column chromatography, advantages and limitations.

REFERENCES:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D Christian, 5th edition, 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A Day and A.L. Underwood, 6th edition, 1993prentice Hall, Inc. New Delhi.
4. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham, R.C Denney, J.D Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principals, John H. Kennedy, 2nd edition, Saunders College Publishing California, 1990.

CPP 2.5 (2.1)

Practical Inorganic Chemistry-2

64 Hours

Semimicro qualitative analysis of mixtures containing TWO anions and TWO cations and ONE of the following less common cations.

W, Mo, Ce, Th, Ti, Zr, V, U and Li.

REFERENCES:

1. Vogel's Qualitative Inorganic Analysis- Svelha.
2. Macro and semimicro inorganic qualitative analysis – A.I Vogel.
3. Semimicro Qualitative Analysis –F.J. Welcher and R. B. Halin.
4. Semimicro Qualitative Analysis – Ramanujam.

CPP-2.6 (2.2)

Practical Organic Chemistry – 2

PART-I **64 Hours**

Qualitative analysis: Separation of binary mixtures, identification of functional group and preparation of suitable derivatives (10 DIFFERENT MIXTURES).

PART-II

Spectroscopic interpretations of organic molecules using UV, IR, 1H-NMR, 13C NMR and mass spectral analysis.

REFERENCES:

1) A text book of practical organic chemistry – AI Vogel Vol I
2) Practical organic chemistry –Mann &Saunders
3) Manual of organic chemistry – Dey and Seetharaman
4) An introduction to practical organic chemistry – Robert, Vingrove etc.
5) Semimicro qualitative organic analysis by Cheronis, Entrikin and holdnet
6) J.N. Guthru & R. Kapoor, Advanced experimental chemistry, S. Chand Company, new Delhi, 1991.
7) N. K. Visno, Practical organic chemistry, New PGE International (P) Ltd. London, 3rd edition, 1996.
8) Organic spectroscopy by- W Kemp
9) Spectroscopy of Organic Compounds - Silverstein
10) Spectroscopy of Organic Compounds – P S Kalsi
11) Introduction to Spectroscopy by Pavia

SPP 2.7.A (2.3.A)

Practical Physical Chemistry

64 Hours

2) Determination of the equivalent conductance of a weak acid at different concentrations and verify Ostwald's dilution law and calculate the dissociation constant of the acid.
3) Determination of equivalent conductance of a strong electrolyte at different concentrations and examine the validity of the Onsager's theory as limiting law at high dilutions.
4) Determination of the activity co-efficient of zinc ions in the solution of 0.002 M Zinc sulphate using Debye-Huckel limiting law.
5) Determination of the solubility product of silver bromate and calculate its solubility in water and in 0.01 M $KBrO_3$ using Debye-Huckel limiting law.
6) Conductometric titrations of a mixture of HCl, CH_3COOH and $CuSO_4$ and NaOH.
7) Determination of the dissociation constant of an acid at different dilution.
8) Determination of the solubility of the lead iodide in water , 0.04 M KI and 0.04 M $Pb(NO_3)_2$ at 298 K
9) Determine the solubility and solubility product of silver benzoate in water at different temperatures.
10) Compare the relative strength of acetic acid and mono chloroacetic acid by conductance method.
11) Determine the electrode potentials of Zn and Ag electrodes in 0.1M and 0.001M solutions at 298 K and fine the standard potentials for these electrodes and test the validity of Nernst equation.
12) Determine the transport number of cadmium ions and sulphate ions by measuring emf of concentration cells with and without transference.
13) Determine the activity co-efficient of an electrolyte at different molalities by EMF measurements.
14) Determine the dissociation constant of acetic acid titrating it with sodium hydroxide using quinhydrone as an indicator electrode and calomel as a reference electrode.
15) Perform acid-base titration in a non-aqueous medium.
16) Determine the dissociation constant of acetic acid in DMSO, DMF and acetone by titrating it with KOH.
17) Determination of redox potential and estimation of Fe^{2+} ions by potentiometric method.
18) Potentiometric titration of a mixture of halides (KCl+ KI and KCl+ KBr+ KI) against $AgNO_3$
19) Potentiometric titration of KI Vs $KMnO_4$ solution.
20) Conductometry – to determine the degree of hydrolysis and hydrolysis constant of aniline hydrochloride.
21) Infrared spectral data analysis of inorganic and organic compounds

REFERENCE:

13. Practical Physical chemistry – A.J. Findlay.
14. Experimental Physical Chemistry – F. Daniels et al.
15. Selected Experiments in Physical Chemistry – Latham.
16. Experiments in Physical Chemistry – James and Prichard.
17. Experiments in Physical Chemistry – Shoemaker.
18. Advanced Physico – Chemical experiments – J. Rose.
19. Practical Physical Chemistry. - S.R. Palit.
20. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
21. Experiments in Physical Chemistry – Palmer.
22. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994)
23. Experimental physical chemistry, R. C. Das and B. Behera, Tata McGraw-Hill Publishing Company Limited, 1983.
24. Experimental Physical Chemistry, V. D. Athawale and Parul Mathur, New Age International (p) Limited, Publishers, New Delhi, 2001.

SPP 2.7.B (2.3.B)

Practical Physical Chemistry

64 Hours

1. To determine CMC of the given surfactant by surface tension method.
2. Study of variation of surface tension of solution of n-propyl alcohol with concentration and hence determine the limiting cross section area of alcohol molecule.
3. Clock reaction- activation energy of bromide-bromate reaction.
4. Investigate the Autocatalytic reaction between potassium permanganate and oxalic acid.
5. Determination of pK_a value of a weak acid by chemical kinetic method (formate-iodine reaction)
6. Hydrolysis constant by aniline-hydrochloride by potentiometry and conductometry
7. pK_a of weak acids by potentiometry and conductometry.
8. Complexation between $Hg^{2+}$and I^- conductometrically.
9. Estimate the concentration of H_2SO_4, CH_3COOH, $CuSO_4.5H_2O$ in a given solution by carrying out conductometric titration against NaOH solution.
10. 10 .Determine the eq. conductance of strong electrolyte (KCl, NaCl, HCl,KNO_3) at several concentration and hence verify Onsager's equation.
11. Carry out the following precipitation titration conductometrically
    a. $AgNO_3$ with HCl

    b. $AgNO_3$ with KCl

    c. $MgSO_4$ with $Ba(OH)_2$

    d. $BaCl_2$ with Li_2SO_4

12. Determination of redox potential of the couples (Fe^{2+}/Fe^{3+}, $Co^{3+}/Co^{2+,}$ $Cr^{3+}/Cr^{2+,}$ MnO_4^-/Mn^{2+} (any two) and equilibrium constant.

25. Study of complex formation by potentiometry e.g. Ag^+-$S_2O_3^{2-}$, Fe^{3+}-SCN^-, Ag^+-NH_3 (any two) and calculation of stability constant.

REFERENCE:

1. Practical Physical chemistry – A.J. Findlay.
2. Experimental Physical Chemistry – F. Daniels et al.
3. Selected Experiments in Physical Chemistry – Latham.
4. Experiments in Physical Chemistry – James and Prichard.
5. Experiments in Physical Chemistry – Shoemaker.
6. Advanced Physico – Chemical experiments – J. Rose.
7. Practical Physical Chemistry. - S.R. Palit.
8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.
10. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994)
11. Experimental physical chemistry, R. C. Das and B. Behera, Tata McGraw-Hill Publishing Company Limited, 1983.
12. Experimental Physical Chemistry, V. D. Athawale and Parul Mathur, New Age International (p) Limited, Publishers, New Delhi, 2001.

OEP 2.8 (2.4)
Quantitative analysis and Separation Techniques

64 Hours

Acid – base titrations.

1. Determination of carbonate and bicarbonate in a mixture by pH-metric titration and comparison with visual acid- base titration.
2. Determination of total acidity of vinegar and wines by acid – base titration.
3. Determination of aniline by non – aqueous acid – base titrations.
4. Determination of replaceable hydrogen and relative molecular mass of a week organic acid by titration with NaOH.
5. Determination of total alkalinity of soda ash by visual and pH-metric titrations.
6. Analysis of sulphathiazole tablets by non-aqueous titration with tetrabutylammonium hydroxide.
7. Determination of saponification value of edible oils.

Precipitation titrations

1. Determination of percentage of chloride in a sample by precipitation titration – Mohrs, Volhard and Fajans methods.
2. Determination of sulphate in ground water by titration with $BaC1_2$ using an adsorption indicator.
3. Determination of saccharin in tablets by precipitation titration.

Complexometric titrations

1. Determination of total hardness of water by complexation titration using EDTA.
2. Determination of calcium in milk powder by EDTA titration.
3. Determination of calcium in calcium gluconate / calcium carbonate tablets or injections by EDTA titration.
4. Determination of chloride content of an industrial effluent by conductometric titration with silver nitrate.
5. Analysis of an industrial effluent for sulphate by conductometric titration with $BaC1_2$.

Separation Techniques

1. Determination of iron as the 8-hydroxyquinolate by solvent extraction method.
2. Determination of total cation concentration of tap water by ion-exchange chromatography.
3. Anion-exchange chromatographic separation of Zinc and Magnesium followed by EDTA titration of the metals.
4. Anion-exchange chromatographic separation of chloride and bromide in a mixture.
5. Determination of magnesium in milk and magnesium tablets by ion-exchange chromatography.
6. Determination of iron in mustard seeds and phosphorus in peas by spectrophotometry
7. Separation of metal ions by paper chromatography and their identification
8. Thin-layer chromatographic separation of nitroanilines on fluorescent sheets.

REFERENCES:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D Christian, 5th edition, 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A Day and A.L. Underwood, 6th edition, 1993prentice Hall, Inc. New Delhi.
4. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham, R.C Denney, J.D Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principals, John H. Kennedy, 2nd edition, Saunders College Publishing California, 1990.

CPT-3.1
Reactions, Rearrangements and Heterocyclic chemistry

UNIT – I **16 Hours**

Free Radical Reactions: Types, mechanisms of free radical substitution reactions & neighboring group assistance. Reactivity for the aliphatic and aromatic substances at a bridgehead. Reactivity of attacking radical. Effect of solvent on reactivity. Auto-oxidation, coupling of alkynes.

Reactions of carboxylic acids and their derivatives: Mechanisms, Base catalyzed Bimolecular and Acyl-Oxygen Fission Ester Hydrolysis (B_{AC}-2), Acid-catalyzed Bimolecular and Acyl-Oxygen Fission Ester Hydrolysis (A_{AC}-2), Acid-catalyzed Unimolecular and Acyl-Oxygen Fission Ester Hydrolysis (A_{AC}-1), Acid-catalyzed Unimolecular and Akyl-Oxygen Fission Ester Hydrolysis (A_{Al}-1), Base catalyzed Unimolecular and Akyl-Oxygen Fission Ester Hydrolysis (B_{Al}-1), Base catalyzed Bimolecular and Akyl-Oxygen Fission Ester Hydrolysis (B_{Al}-2). Hydrolysis of Acid Anhydrides and Chlorides, Formation and Hydrolysis of Amides, Decarboxylation mechanisms and Transesterification.

UNIT – II **16 Hours**

Organic Name reactions: Reactions, Mechanisms and synthetic uses of the following: Stolbe condensation, Darzen condensation, Gattermann-Koch reaction, Cannizzaro reaction, Chichibabin reaction, Benzoin condensation, Claisen-Schmidt condensation, Claisen reaction, Simon-Smith reaction, Stork Enamine reactions, Sharpless asymmetric epoxidation, Hofmann-Loffler-Freytag reaction, Prins reaction, Knoevenagel reaction, Sandmeyer reaction, Ullmann reaction, Paterno Buchi reaction, Wittig reaction-Mitsunobu reaction, Robinson annulation, Dickmann cyclisation and Diel's- Alder reactions.

UNIT – III **16 Hours**

Molecular rearrangements: Classification and general mechanistic treatment of nucleophilic, electrophilic and free radical rearrangements. Intermolecular and Intramolecular migration, nature of migration and migratory aptitudes. Mechanism of Wagner-Meerwein, Dienone-Phenol, Pinacol-Pinacolone, Demaynov, Benzil-Benzilic acid, Fries, Wolff, Favorskii, Neber, Benzidine, Baeyer-Villiger, Beckmann, Lossen, Curtius, Schmidt, Stevens, Shapiro, Baker-Venkatraman and Amadori rearrangement.

UNIT – IV **16 Hours**

Chemistry of Heterocyclic Compounds: Introduction, Classification, nomenclature and reactivity of Heterocyclic compounds. Five membered simple and fused heterocycles-synthesis & reactions of derivatives of furan, pyrrole and thiophene. Indole and its derivatives. Detail study of Fisher and Bischler syntheses.

Preparation of benzofurans (coumarins). Quinolines and Isoquinolines. Skraup synthesis. Friedlander and Pfintzinger methods for Quinoline derivatives. Preparation of isoquinolines using Bischler-Napieralski and Pictet methods. Chemical properties,

Electrophilic and Nucleophilic substitution reactions.

REFERENCES:

1. Organic Reactions and Their Mechanisms- P.S. Kalsi (New Age, New Delhi),1996.
2. Advanced Organic Chemistry 4th Edn- J. March (Wiley, NY) 2000.
3. Organic Reaction Mechanisms- Bansal (Tata McGraw Hill, New Delhi) 1978.
4. Organic Chemistry-Vol. –I & II-Mukherji, Singh and Kapoor. (Wiley Eastern, New Delhi) 1985.
5. Mechanism and Theory in Organic Chemoistry-Lowry and Richardson Harper and Row, 1987.
6. An Introduction to the Chemistry of Heterocyclic Compounds-Acheson (Wiley – Eastern) 1987.
7. Heterocyclic Chemistry-J. Joule & G. Smith, (Van-Nostrand, ELBS), 1978.
8. Reaction Mechanisms in Organic Chemistry-Mukherji, Singh and Kapoor (McMillan) 1978.
9. Organic Chemistry-P.Y. Bruice (Pearson Education, New Delhi) 2002.
10. F. A. Carey and Sundberg, Advanced Organic Chemistry-Part A and B, 3rd edition, Plenum Press, New York, 1990.
11. Comprehensive Organic Synthesis- B. M. Trost and I. Fleming series, Pergamon Press, New York, 1991.

CPT 3.2
Chemical Kinetics and Surface Phenomena

UNIT – I 16 Hours

Kinetics of complex reactions: parallel, consecutive and reversible reactions. Determination of order of reaction. Arrhenius equation, energy of activation and its experimental determination. Simple collision theory-mechanism of bimolecular reaction. Lindemann's theory, Hinshelwood's theory for unimolecular reaction.

Activated complex theory of reaction rate, classical thermodynamic treatment, partition function, statistical thermodynamic treatment. Kinetics of reactions in solution-Salt effects, effect of dielectric constant (single sphere and double sphere mode), effects of pressure, volume and entropy change on reaction rate. Cage effect with an example. Kinetics of heterogeneous reactions-Langmuir's theory, unimolecular and biomolecular surface reactions.

UNIT – II 16 Hours

Fast reactions: Study of kinetics by flow techniques, equation for constant time, stopped flow and continuous flow methods. Relaxation method, equation for relaxation time, temperature jump and pressure and pressure jump methods, flash photolysis, pulse radiolysis and shock tube method.

Potential energy surface, theoretical calculation of energy of activation**.**

Chain reactions: Rice-Herzfeld mechanism for the thermal decomposition of acetaldehyde, kinetics of explosive reactions, explosion limits (H_2 and O_2 reaction) Kinetics of autocatalytic and oscillatory chemical reactions, oscillatory chemical reaction of oxidation of malic acid by bromate ion catalyzed by Ce (III). Catalyzed and unanalyzed reaction: Ru (III) catalyzed oxidation reaction of primary amines by chloramine-T in HCl medium**.**

Catalysis by enzymes - rate of enzyme catalyzed reactions - effect of substrate concentration, pH and temperature on enzyme catalyzed reactions - inhibition of enzyme catalyzed reactions.

UNIT – III 16 Hours

Kinetic methods of analysis: Analytical uses of reaction rates relative, basis of reaction rate methods, rate laws-first and second order reactions relative rates of reactions, analytical utility of first or pseudo first order reactions, determination of reaction rates, types of kinetic methods-differential methods, integral methods, multicomponent analysis-neglect of reaction of slow-reacting component, logarithmic extrapolation method, reaction rate method, applications-catalyzed reactions, measurement methods for catalyzed reactions, micro determination of inorganic species like iodine, selenium, cobalt and mercury in complex materials, determination of organic species, non-catalytic reactions. Applications of enzyme- catalyzed reactions for the analysis of substrates-stiochiometric and rate methods, determination of urea, uric acid, blood glucose

galactose and blood alcohol, determination of enzymes-LDH, GOT and GPT.

UNIT – IV **16 Hours**

Surfaces and interfaces: Types of interfaces. Liquid surfaces: Microscopic picture of interfaces; curved interfaces; Young -Laplace and Kelvin equations; capillary condensation; surface tension; measuring surface tension. Solid-liquid interfaces: Contact angle and wetting, Gibbs adsorption isotherm. Solid surfaces: External and internal surfaces; Bulk and surface structure of FCC, BCC and HCP metals; Notation of surface structures; Relaxation and reconstruction of surfaces; homogeneous and heterogeneous surfaces. Solid-gas interfaces: Types of adsorption; Adsorption isotherms – Langmuir, Tempkin and BET. Determination of surface area of adsorbents; temperature dependence of adsorption isotherms.

Dispersed systems: Types of dispersions; Spontaneous self-organization; Surfactants: structure of surfactants in solution; critical micellation concentration (CMC); temperature dependence; influence of chain length and salt concentration; surfactant parameter. Emulsions: macro- and micro-emulsions; aging and stabilization of emulsions; Phase behaviour of microemulsions. Colloids, vesicles, lipid bilayer membrane: structure and properties, monolayers, liquid crystals, foams and aerosols.

REFERENCES:

1. Chemical Kinetics by K. J Laidler
2. Chemical Kinetics- Moore and Pearson
3. Kinetics and Mechanism of Chemical Transformation by J. Rajaram and J. C. Kuriacose.
4. Chemical Kinetics – S. K Jain
5. Chemical Kinetics- Benson
6. Elements of Physical Chemistry – Lewis and Glasstone
7. Physical Chemitry by P . W Atkins, ELBS, 4th Edition, Oxford University Press (1990)
8. Kinetics in Analytical Chemistry- H. B. Mark and G. A Rechnitz. Interscience Publishers. John Willey and Sons, New York.
9. A.W. Adamson, A.P. Gast, Physical chemistry of surfaces, Wiley, 1997.
10. H.-J. Butt, K. Graf, M. Kappl, Physics and Chemistry of Interfaces, Wiley-VCH, 2006.
11. D.K. Chakrabarty and B. Viswanathan, Heterogeneous Catalysis, New Age, 2008.
12. H. Kuhn, H.-D. Forsterling, D.H. Waldeck, Principles of Physical Chemistry, Wiley, 2009.
13. G.A. Somorjai, Y. Li, Introduction to Surface Chemistry and Catalysis (2n ed.), 2010.
14. Surface area and porosity determination by physisorption measurements and theory, James B condon, Elsevier Science; 1 edition (October 11, 2006).
15. Physical chemistry of surfaces, Arthur W Adamson, Alice P Gast, 6th Edition, Wiley India Pvt. Ltd, 2012.
16. Chemical Physics of Colloid systems and interfaces, Peter A Kralchevsky, Krassimir D. Danov and Nikolai D Denkov, http://lcpe.uni-sofia.bg/publications/2008/2008-09-PK-KD-ND-Handbook-Birdi-3rd-Edition.pdf

SPT – 3.3.A

Organometallic Chemistry & Inorganic spectroscopy

UNIT – I **16 Hours**

Organometallic chemistry: Introduction, 16 and 18 electron rule, classification of organometallic compounds by bond type, nomenclature.

Chemistry of organometallic compounds: synthesis and reactions of organozinc and organolithium reagents (n-BuLi, PhLi).

Metal Carbonyls Complexes: Preparation, Structure, chemical bonding in metal carbonyls, physical evidence related to M-CO bonding. Preparation of anionic metal carbonyl complexes and substituted metal carbonyl complexes.

Metal nitrosyls: Preparation, linear and bent nitrosyls.

Cyclopentadienyl Metal Complexes: Preparation, structures of Cyclopentadienyl Metal Complexes. M. O diagram for ferrocene. Reactions and aromaticity of ferrocene.

Metal –arene Complexes: methods of preparation of arene complexes, reactions of metal –arene complexes Structure, chemical bonding in metal-arene complexes.

Heterocyclic Sandwich compounds: preparation and properties.

Olefin-transition metal complexes: methods of preparation, structure and bonding metal olefin complexes.

UNIT – II **16 Hours**

Conjugated diolefins and related metal complexes. preparation, structure and bonding.

Acetylene and acetylene derived metal complexes: preparation, structure and bonding in acetylene complexes. Reactions of coordinated acetylene.

Pi-allylic metal complexes: preparation complexes containing allylic ligands, Structure and bonding.

16 Hours

Reaction kinetics of coordination compounds: Introduction, electron transfer reactions: Outer sphere reactions, the Marcus theory, ligand-bridged inner sphere reactions doubly-bridged inner-sphere transfer, one electron and two electrons transfers, non-complementary reactions. Ligand exchange via electron exchange.

Mechanisms of ligand substitution reactions-general considerations, substitution reactions of square planar and octahedral complexes. Base catalyzed hydrolysis of cobalt (III) ammine complexes.

Metal-metal bonding: Evidences and factors favouring of M-M bonding, bi, tri, tetra, penta and hexa nuclear metal clusters.

Thermodynamic and related aspects of ligand fields: Hydration**,** ligation and lattice energies.

UNIT – III **16 Hours**

Electron Spin Resonance Spectroscopy: Basic principles- intensity-width-position and multiple structure. General rules for the interpretation of the spectra. Zero field splitting and Kramer's degeneracy rule. Factors affecting the magnitude of 'g' value. Double resonance-ENDOR and ELDOR. Applications-study of free radicals-structure determination- biological study-coordination compound and analytical applications.

Mossbauer spectroscopy: Theoretical basis. Interpretation of Mossbauer spectra- isomer shift- Quadrupole splitting and magnetic hyperfine structure, time and temperature effects. Instrumentation. Applications-structure deducetion-$I_2Br_2Cl_4$, $Fe_3(CO)_{12}$

NQR Spectroscopy: Energies of the Quadrupole transitions, effect of magnetic field on the spectra, relationship between electric field gradient and molecular structure. Applications- interpretation of e^2Qq data. Structural information from NQR spectra.

UNIT – IV **16 Hours**

UV-VIS Spectroscopy (Outer shell electronic spectroscopy): Quantitative aspects of absorption –Beer's law. Terminology associated with absorption measurements. Limitations of the law: Real, Chemical, instrumental and personal. Theory of molecular absorption. Vibration-rotation fine structure of electronic spectra. Types of absorption bands: $n\rightarrow\pi^*$, $\pi\rightarrow\pi^*$, $n\rightarrow\sigma^*$, $\sigma\rightarrow\sigma^*$, C-T and ligand field. Empherical rules for predicting the wave length of maximum absorption: Olefins, conjugated dienes, cyclic trienes and polyenes –α, β-unsaturated aldehydes and ketones, benzene and substituted benzene rings. Basic components of instrumentation, single and double beam deigns. Applications: Qualitative and quantitative analysis of binary mixtures, measurement of dissociation constants of acids and bases, determination of molecular weight, photometric titrations, Determination of stoichiometry and stability of the complexes and kinetic studies.

REFERENCES:

1. Inorganic Chemistry- F. A. Cotton and G .Wilkinson (2nd edition)
2. Organometallic Chemistry- R. C. Mehrothra and A. Singh
3. Spectroscopy by B P Stranghan and S Walker, John Wiley and Sons, Inc., New York, Vol. I and 2 , 1976
4. Organic spectroscopy by Willaa Kemp, ELBS Society, MacMillan, 1987.
5. Application of absorption spectroscopy of organic compounds by JohnR. Dyer, Prentice-Hall of India Pvt. Ltd., New Delhi.1974.
6. Organic spectroscopy by V.R. Dhani, Tata McGrow-Hill Publishing company Ltd., New Delhi, 1995.
7. Spectometric identification of organic compounds, 4th edition, Robert M, Silverstein, G. Clayton Bassler and Terence C. Morrill, John Wiley and Sons Inc., New York, Vol.1, 1981
8. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
9. Instrumental method of analysis, Hobart H, Willard, Lynne L, Merritt, Jr., John A. dean and franmk A Settle, Jr., 6th edition, CBS Publishers and Distributors, Delhi, 1986.
10. Physical methods for chemists by R.S. Drago, Sunders College publishing, New York.
11. Quantitative Analysis, R. A Day and A./L Underwqood, 6th edition, prentice Hall, Inc., 1999.
12. Principles of instrumental Analysis, D.A.Skoog, F.J Holler and T.A. Nieman, 5th edition, Thomson Asis Pvt. Ltd. Singapore,1998.

SPT – 3.3.B

Industrial and Materials Chemistry

UNIT – I **16 Hours**

Inorganic rings, cages and polymers: Chemistry and structures of boranes, carboranes and metalloboranes; applications of silicates and zeolites; synthesis, properties and structures: isopoly and heteropoly molybdates, phosphates and tungstates; Silicone polymers: silicone oils, rubber, grease and resin. Crown ethers, composites, thermoelectric materials, luminescent and phosphor materials.

UNIT – II **16 Hours**

Liquid Crystalline Materials – Introduction, Chemistry and applications: Thermotropic & Lyptropic liquid crystals, structure and property relationship, Smectic,nematic &cholestric liquid crystals, globular and discotic liquid crystals, liquid crystalline polymers. Applications of liquid crystals in chemistry, electronics, medicine and non destructive testing.

Molecularly Engineered Structures – Pillared layered compounds, clay materials, Zeolites, Feldspars, Clathrasils, Zeosils, porosils, micro and meso porous compounds.

UNIT – III **16 Hours**

Introduction to nanoscale, Basic nanotechnology, basic nanostructures; Nanostructures: Nanostructures: tubes, fibers, wires, bricks and building blocks, quantum confinements;

Synthesis of Nanomaterials: Physical Methods: Mechanical methods– high energy ball milling and melt mixing.

Film Deposition Methods: Introduction, fundamentals of film deposition. Evaporation methods– thermal evaporation, with consolidation, ionized cluster beam deposition, laser vapourization, pulsed laser deposition. Sputter deposition (dc and rf), magnetron sputtering, chemical vapour deposition.

Chemical Methods: Growth of nanoparticles, Synthesis of metal nanoparticles by colloidal route, Microemulsions, sol-gel method, precipitation.

Sol-Gel Processing: Fundamentals of sol-gel process – sol-gel synthetic methods for oxides – silica, zinc oxide, iron oxide, alumina and other inorganics and nano composites

Biological Methods: Synthesis using microorganisms, plant extracts, use of proteins and templates like DNA.

UNIT – IV **16 Hours**

Application of Nanomaterials: Quantum dot IR photo detectors- Quantum dot lasers – Synthesis of Zinc oxide nanomaterials and its application – Synthesis of group three nitride nanostructures and their applications.

MEMS, field emission display devices, nanodiodes, nanoswitches, molecular switches, Super hard nanocomposite coatings and applications in tooling.

Magnetic Storage: magnetic quantum well; magnetic dots - magnetic date storage - high density quantized magnetic disks - magnetic super lattices – MRAMS

Nano based drug delivery and imaging.

REFERENCES:

1. Inorganic Chemistry : Shriver & Atkins (4th edition 2003, Oxford)
2. Concise Inorganic Chemistry, J. D. Lee, Fourth Edn.(Chapman and Hall)
3. Inorganic chemistry: principle of structures and reactivity, Huheey, Keiter, Keiter, Medhi, Pearson Education, Fourth Edn.(2007).
4. Inorganic Chemistry: Catherine Housecroft
5. Inorganic Chemistry: Messler & Tarr, Pearson Publishers 3rd Edition
6. Nano Science and nanotechnology in engineering, by V. K. Varadhan, A. S. Pillai, D. Mukharjee,
7. M. Dwivedi and L. Chen, World Scientific Publishing Company, Pvt. Ltd.
8. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
9. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
10. Bio-Inspired Nanomaterials and Nanotechnology, Edited by Yong Zhou, Nova Publishers.
11. Nano: The Essentials: Understanding Nanoscience and Nanotecnology, T. Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
12. Nanochemistry: A Chemical Approach to Nanomaterials – Royal Society of Chemistry, Cambridge, UK (2005).
13. Nanocomposite science and technology, Pulickel M.Ajayan, Linda S.Schadler, Paul V.Braun, Wiley-VCH Verlag, Weiheim (2003).
14. Encyclopedia of Materials Characterization, C. Richard Brundle, Charles A. Evans Jr., Shaun Wilson, Butterworth-Heinemann Publishers (1992).
15. Nanocrystals: Synthesis, Properties and Applications, C. N. R. Rao, P. J. Thomas and G. U. Kulkarni, Springer (2007).
16. Handbook of Microscopy for Nanotechnology, Ed. By Nan Yao and Zhong Lin Wang, Kluwer Academic Press (2005).
17. Nanochemistry, G. B. Sergeev, Elsevier (2006).
18. T. R. Hsu, MEMS and microsystems design and manufacture, Boston, McGraw Hill, 2002.
19. S. E. Lyshevski, Nano- and microelectromechanical systems, Boca Raton, CRC Press, 2001.
20. R. Waser (ed.), Nanoelectronics and information technology, Aachen, Wiley-VCH, 2003.
21. B. Bhushan, Springer handbook of nanotechnology, Berlin, Springer-Verlag, 2004.
22. J. A. Pelesko and D. H. Bernstein, Modeling MEMS and NEMS, Boca Raton, Chapman &Hall/CRC, 2003.
23. S. K. Kulkarni, Nanotechnology Principles and Practices, Captial Publishing Company, Bangalore, 2009.
24. T. Pradeep, Nano - The essentials, Understanding Nanoscience and Nanotechnology, Tata Mc Graw Hill, 2007.
25. Inclusion Compounds Vol. 4, Ed. by J. L. Atwood, J. E. D. Davies and D.D. McNicol (Oxford University Press), 1991.
26. Liquid Crystals and plastic Crystals eds. P.A. Winsor and G.W. Gray vol. I & II (John Wiley & sons).
27. Molecular structure and properties of Liquid crystals, G.M. Gray.
28. Liquid Crystals – S. Chandrasekhar (Cambridge University Press).

OET-3.4
Environmental Chemistry

UNIT – I 16 Hours

Atmospheric chemistry: The structure of the earth's atmosphere- chemistry of the lower and upper atmosphere. The chemistry of air pollution- oxides of nitrogen- hydrogen sulphide and oxides of sulphur- Aerosols – ozone depletion and consequences- dioxins burning plastics- other atmospheric chemicals- smog- Greenhouse effect- Global warming, oxides of carbon.

UNIT – II 16 Hours

Water pollution and analysis: Water resources, origin of waste water, types of water pollutants of their sources and effects, chemical analysis for water pollution control - objectives of analysis, parameters of analysis, sample collection and preservation.

Environmental and public health significance and measurement of colour, turbidity, total solids, acidity, alkalinity, hardness chloride, residual chlorine, chlorine demand, sulphate, fluoride, phosphates and different forms of nitrogen in natural and waste/polluted waters, heavy metal pollution-public health significance of Pb, Cd, Cr, Hg, As, Cu, Zn, and Mn, general survey of the instrumental techniques for the analysis of heavy metals in aquatic systems, organic loadings-significance and measurement of DO, BOD, COD, TOD, and TOC, phenols, pesticides, surfactants and tannin and lignin as water pollutants and their determination.

UNIT – III 16 Hours

Waste water treatment: Waste water characteristics, effluent standards, terminology in Waste water treatment. Treatment of domestic waste water - preliminary treatment.
Primary treatment: Sedimentation, equalization, neutralization.
Secondary treatment: Aerated lagoons, trickling filters, activated sludge process, oxidation ditch, oxidation pond and anaerobic digestion. Sludge treatment and disposal.
Tertiary treatment: Evaporation, ion-exchange, adsorption, electrodialysis, electrolytic recovery and reverse osmosis.
Advanced waste water treatment: Nutrient removal- nitrogen and phosphorus removal, solids removal.
Waste water disposal and reuse: Industrial waste water and its treatment.

Soil analysis: Inorganic and organic components of soil, collection and preparation of soil samples for analysis. Measurement of soil pH and conductivity. Determination of organic carbon, total nitrogen, available nitrogen, ammonia nitrogen, nitrite nitrogen and nitrate nitrogen. Available phosphorus and sulphur – their determination. Analysis of soil for sodium, potassium and calcium and magnesium. Micronutrient elements and their analysis. Pesticide residues in soil, their separation and determination.

UNIT – IV **16 Hours**

Radioactive pollution: Radioactive materials, Sources of radioactive pollutants, Effects of radioactive pollutants on living organism, Case study – Chernobyl disaster

Noise and Thermal Pollution: Noise pollution – source, measurement, effects and control; Thermal pollution - causes, effects and control.

REFERENCE:

1. Environmental Science (8th Edition) (2010): Daniel D. Chiras, Jones & Bartlett Ltd
2. A textbook of Environment: K. M. Agarwal, P. K. Sikdar & S. C. Deb
3. Environmental Analysis : M. M. Saxena
4. Environmental Chemistry : A. K. De
5. Environmental Chemistry : B.K. Sharma, and H. Kaur
6. Environmental Chemistry : S. E. Manahan
7. Environmental Science : S. C. Santra,
8. Environmental Science (6th ed) (1997): Jr. G. T. Miller, Wadsworth Pub. Co.
9. Environmental Science: D. D. Chiras
10. Forestry – Segreiya : Champion and Seth.
11. Fundamentals of Ecology : E. P. Odum
12. Hydrology – Principles, Analysis and Design: H. M. Raghunath
13. Instrumental Methods of Analysis: Chatwal and Anand.
14. Instrumental Methods of Analysis : G. W. Ewing
15. Introduction to Environmental Engineering and Science: G. M. Masters
16. Introduction to Weather and Cliamte : Trewartha
17. Modern concepts in Ecology : H. D. Kumar
18. Renewable Energy and Environment: N.H. Ravindranath, K. Usha Rao, Bhaskar
    1. Natrajan and Pradeep Monga.. CEE, Ahmedabad, 2000.
19. The ISO 14000 Handbook: Joseph Cascio.
20. Wasteland Development – Khan, et al.,
21. Environmental Statistics and Data Analysis: Wayne, R. Ott (1995).CRC Press.
22. Environmental Science – A study of Inter relationships, E. D. Enger, B. E. Smith, 5th
23. A. K. De. Environmental Chemistry (4th edn.), New Age International Limited (2006).
24. H. H. Willard, L.L. Merritt, J.A. Dean & F. A. Settle. Instrumental Methods of Analysis (7th edn.), Wadsworth Publishing Company, California (1988).
25. J. Mendham, R. C. Denney, J. D. Barnes and M. Thomas. Vogel's Textbook of Quantitative
26. Chemical Analysis, Peterson Education (2000). Chemistry of environmental engineering, Chair
27. The pollution hand Book, Richard Mabey, Penguin 1978.Soil Chemical analysis, M. L. Jackson, Prentice Hall of India pvt. Ltd. New Delhi, 1973.
28. J. W. Moore & E. A. Moore. Environmental Chemistry, Academic Press, London (1976).
29. I. Pulford & H. Flowers. Environmental Chemistry at a Glance, Blackwell Publishing (2006).
30. S. E. Manahan. Environmental Chemistry (6th edn.), Lewis Publishers, London (1994).

CPP - 3.5 (3.1)
Practical Organic Chemistry – 3

64 Hours

Part-I

Quantitative Analysis:

1. Determination of alcoholic group by acylation.
2. Determination of phenolic by bromination.
3. Determination of amino by acylation.
4. Determination of amino by bromination.
5. Determination of nitro group.
6. Estimation of sugars by Fehling's Method
7. Determination of equivalent weight of a carboxylic acid.
8. Estimation of uric acid
9. Estimation of cholesterol.

Part-II

Preparation of the following synthetic compounds

1. Preparation of Benzimidazole from O-pheneylene diamine
2. Preparation of PAS from p-nitrosalicylic acid
3. Preparation of Dichloramine T from toluence p-sulphonamide
4. Preparation of Chloramine T from Dichloramine T
2. Preparation of Fluorescein from Pthalicanhydride
3. Preparation of Eosin from Fluorescin
4. Preparation of Sulphacetamide from sulphanilamide
5. Preparation of Phenothiazine from Diphenylamine
6. Preparation of Cinnamic acid from perkin's reaction
7. Preparation of Benzyl alcohol by cannizzaros reaction
8. Preparation of INH from Isonicotinic acid
9. Preparation of Chlorobutanol
10. Preparation of Napthoquinone
11. Preparation of Quinoxaline
12. Preparation of Benzotriazole
13. Preparation of 3-Diphenyl quinolone
14. Preparation of 2,4,5-Triphenyll imidazole from Benzoin

REFERENCES:

1. Manual of organic chemistry – Dey and Seetharaman
2. Natural products chemistry by Raphel Ikhan
3. Modern experimental organic chemistry by John H. miller and E. F. Neugil p289.
4. An introduction to practical organic chemistry – Robert, Vingrove etc
5. A text book of practical organic chemistry – A. I. Vogel Vol I
6. Practical organic Chemistry – Mann and Saunders
7. Semimicro qualitative analysis by Cheronis, Entrikin and Hodnet.
8. I.L, Finar, Organic chemistry vol I and II, Sixth Edition, 2003, ELBS.
9. R. O. C. Norman and J. M. Coxon, Principals of Organic Synthesis, Third Edition, 1995, ELBS.
10. R. J. Morrison and R. N. Boyd Organic chemistry, Fifth edition, Prentice Hall of India Pvt. Ltd., New Delhi.
11. A. H. Beckett and Stanlake, Practical pharmaceutical chemistry
12. J. G. Mann and Saunders, Practical organic chemistry

CPP 3.6 (3.2)

Practical Physical Chemistry - 3

64 Hours

1. Study the kinetics of the decomposition of sodium thiosulphate by mineral acid (0.5M HCI).
2. Study the primary salt effect on the kinetics of ionic reactions
3. To study the acid catalyzed kinetics of oxidation of glycine by chloramines-T (CAT) - determination of order of reaction w.r.t [CAT], [Glycine] and effect of $[H^+]$.
4. Spectrophotometric kinetics of oxidation of indigocarmine by chloramine-T (CAT)
    a) Determination of order of the reaction w.r.t. (CAT).
    b) Effect of pH and determination of order of the reaction w.r.t. (H^+).
5. To determine conductometrically the second order rate constant for the hydrolysis of ethyl acetate by sodium hydroxide.
6. To investigate the autocatalytic reaction between potassium permanganate and oxalic acid
7. To investigate the reaction between potassium persulphate and potassium iodide by colorimetric measurement
8. To determine the bimolecular rate constant of the oxidation of iodide ion by hydrogen peroxide in aqueous solutions at 300K.
9. Kinetics of reaction between sodium formate and iodine, determination of energy of activation.
10. Study the effect of solvent (DSMO-water, acetone-water system) on the rate of acid catalysed hydrolysis of acetal by dilatometry.
11. To determine the critical micelle concentration of sodium lauryl sulphate from the measurement of conductivities at different concentrations
12. To measure the surface tension of carbon tetrachloride at various temperatures by capillary-rise method and to calculate the relative thermodynamic parameters.
13. To determine the surface tensions of solutions of amyl alcohol in water at different concentrations and to calculate the surface excesses of those solutions.
14. To study the adsorption of acetic acid on activated charcoal.
15. To study the kinetics of solvolysis of t-butyl halide by conductivity method.
16. Kinetics of saponification of ethyl acetate by conductivity method and study the effect of dielectric constant of the medium (Using methanol).

REFERENCES:

26. Practical Physical chemistry – A.J. Findlay.
27. Experimental Physical Chemistry – F. Daniels et al.
28. Selected Experiments in Physical Chemistry – Latham.
29. Experiments in Physical Chemistry – James and Prichard.
30. Experiments in Physical Chemistry – Shoemaker.
31. Advanced Physico – Chemical experiments – J. Rose.
32. Practical Physical Chemistry. - S.R. Palit.
33. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
34. Experiments in Physical Chemistry – Palmer.
35. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994)
36. Experimental physical chemistry, R. C. Das and B. Behera, Tata McGraw-Hill Publishing Company Limited, 1983.
37. Experimental Physical Chemistry, V. D. Athawale and Parul Mathur, New Age International (p) Limited, Publishers, New Delhi, 2001.

SPP 3.7.A (3.3.A)

Practical Inorganic Chemistry –3

64 Hours

I. Analysis of alloys:

1. Stainless steel
   a) Nickel gravimetrically using dimethyl glyoxime
   b) Chromium titrimetrically by persulphate oxidation
   c) Iron titrimetrically using cerium sulphate
   d) Chromium and Manganese (Simultaneous Spectrophotometric method)
2. Ferromanganese: Manganese using EDTA.
3. Molybdenum and Tungsten steels; gravimetric
4. Woods alloy
   a) Tin (gravimetric)
   b) Bismuth
   c) Lead | titrimetrically using EDTA
   d) Cadmium

II. Quantitative analysis of the constituents in mixtures containing the following cations.

a. Cu(II) + Fe(II)
   Copper gravimetric as CUSCN
   Iron- titrimetric using Cerium (IV) solution.
b. Cu(II) + Ni(II)- gravimetric using salicylaldoxime.
c. Cr(III) + Fe(III)- Using EDTA (Kinetic Masking)

III. Semi-micrograviметric estimation of aluminium

IV. Electrogravimetric Estimation of
   a. Copper
   b. Nickel
   c. Copper- nickel alloy

V. Flame photometric determination of
   a. Sodium
   b. Potassium
   c. Calcium
   d. Lithium
   e. Sodium + Potassium

VI. Polarographic determination of
   a. cadmium
   b. Zinc
   c. Cadmium + Zinc

VII. Spectrophotometric determination of the pKa Value of an indicator

VIII. Potentiometric determination of cobalt.

IX. Solvent extraction and Spectrophotometric determination of:
   a. Uranium or molybdenum
   b. Nickel

REFERENCES:

1. Advanced physico- chemical experiments- J. Rose
2. Instrumental analysis omanual- Modern Experiments for Laboratory – G. G. Guilbault and L. G Hargis.
3. A Text Book of quanntitaive Inorganic Analysis- 5th edidtion- A. I. Vogel.
4. Experimental norganic chemistry- G. Palmer
5. Inorganic synthesis- O. Glemser.
6. Experimental Inorganic/Physical chemistry- Mounir A. Malati.
7. Spectrophotometric determination of elements- A. Marczenko.

SPP 3.7.B (3.3.B)
Practical Inorganic Chemistry

64 Hours

1. Determination of calcium in milk powder by EDTA titration.
2. Determination of calcium in calcium gluconate / calcium carbonate tablets or injections by EDTA titration.
3. Determination of percentage of chloride in a sample by precipitation titration – Mohrs, Volhard and Fajans methods.
4. Determination of saccharin in tablets by precipitation titration.
5. Analysis of sulphathiazole tablets by non-aqueous titration with tetrabutylammonium hydroxide.
6. Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium (IV) sulphate.
7. Determination of iron in razor blade by visual and potentiometric titration using sodium metavanadate.
8. Determination of calcium in limestone by redox titrations.
9. Determination of copper in an ore/an alloy by iodometric redox titration.
10. Determination of antimony in stibnite by titration with iodine.
11. Analysis of commercial hypochlorite or peroxide solution by iodometric titration.
12. Periodate determination of ethylene glycol (Malprade reaction).
13. Determination of silver in an alloy by Volhard method.
14. Determination of vitamin C in citrus fruit juice by iodimetric/ BrO_3titration.
15. Synthesis of nano size Metal oxides, its characterization by UV-Visible spectroscopy and its photocatalysis
16. Synthesis of liquid crystals and their applications

REFERENCES:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D Christian, 5th edition, 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A Day and A.L. Underwood, 6th edition, 1993prentice Hall, Inc. New Delhi.
4. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham, R.C Denney, J.D Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principals, John H. Kennedy, 2nd edition, 1990.

OEP 3.8 (3.4)

Practical Environmental Chemistry

64 Hours

1. Analysis of ground water sample for sulphate by titrimetry (EDTA) and turbidimetry.
2. Spectrophotometric determination of lead in waste water using solvent extraction procedure.
3. Analysis of waste water for phosphate by Molybdenum blue method
4. Determination of chlorides in water sample
5. Analysis of waste water for total acidity and alkalinity by conductometric titration and comparison with visual methods.
6. Determination of fluoride in drinking water / ground water by spectrophotometry (alizarin red lake method)
7. Analysis of soil sample for organic carbon by titrimetry and spectrophotometry ($K_2C_2O_7$ method)
8. Determination of dissolved oxygen by winkler or iodometric method.
9. Determination of chemical oxygen demand (COD) of water
10. Determination of Ca and Mg in the given sample
11. Estimation of iron in water samples
12. Estimation of nitrates in water samples
13. Determination of SPM in ambient air
14. Spectrophotometric/colorimetric determination (a) determination of nickel. (b) Determination of hexavalent chromium.
15. Redox titration (a) determination of ferrous iron. (b) determination of copper.
16. Soil physical properties (a) particle size distribution analysis (sand, silt and clay) (b) Determination of specific gravity and water holding capacity

REFERENCES:

1. Experiments in Environmental chemistry, F. D. Vowler, and D. W. Counel, Pergamon press, Oxford 1980.
2. Manual soil Laboratory Testing- vol I, K. H. Head, Pentech Press, London 1980.A text Book of Environmental chemistry and pollution control. S. S. Dara, S. Chand and Co, Ltd. New Delhi 2004.
3. Air pollution Vol II Edn. By A. C Stern, Academic press New York 1968.Instrumental methods for automatic air monitoring systems in Air Pollution Control, Part-III Edn by W. Stranss, John-Wiley and sons, New York, 1978.Analysis of air pollutants, P. O. Warner, John Wiley and sons, New York, 1976.
4. The Chemical analysis Air Pollutants, Interscience, New York, 1960.
6. The Analysis of Air Pollutants, W. Liethe, Ann Arbor Science Pub Inc. Michigan 1970. Environmental chemistry A. K De.
7. Jackson ML (1973) Soil chemical analysis. Prentice Hall, New Delhi.

CPT – 4.1
Bioinorganic Chemistry and Catalysis

UNIT – I 16 Hours

Bioenergetics: Energy in biology, energy transfer, standard free energy, entropy, the energy of ATP, kinetic stability of ATP. High energy compounds, mitochondrial flow of electrons from NADH to O_2.

Bioinorganic Chemistry of phosphorus: Phosphates and Bioenergetics. Phosphorylation, oxidative Phosphorylation,- substrate level Phosphorylation, respiratory chair Phosphorylation, mechanism of oxidative Phosphorylation.

Bioinorganic aspects of sodium and Potassium: Sources, absorption, distribution and functions. The transport mechanism, Na^+, K^+ transporting ATP^{ase} (The Na^+/K^+ pump)

Macrocyclic crown ether compounds, cryptands, spherands and ionophores.

Bioinorganic chemistry of calcium and Magnesium. Binding, transport and accumulation of Ca^{2+}, calcium and muscle contraction, calcium in blood cloting mechanism. Chlorophyll and its role in photosynthesis.

Chemistry of Vitamin B_{12} and model compounds. Structure of Vitamin B_{12}, Derivatives of B_{12}, Biochemical functions of B_{12} model compounds.

Biochemical aspects of Molybdenum. Aspects of molybdenum chemistry, Molybdenum containing enzymes - xanthine oxidase, aldehyde oxidase, sulphite oxidase, nitrogenase and nitrate reductase. Nitrogen fixation.

UNIT – II 16 Hours

Role of metal ions on the catalytic mechanism of enzyme. Ligand bridge complex, metal bridge complex and enzyme bridge complex.

Dioxygen metal complexes in biological system. Reactions of molecular oxygen, activation of dioxygen molecule in transition metal dioxygen complexes.

Oxygen carrying proteins: Introduction to porphyrin system, substituent effects on porphyrin rings, hemoglobin and myoglobin, model compounds for oxygen carriers (cobalt, iridium, iron and nickel). Hemerythrin and hemocyanin.

Transport and Storage of Iron; Ferretin, transferrin, phosvitin, and gastroferrin.

Iron transport in microbes: Siderophores, *in vitro* microbial transport of iron.

Electron transport Proteins: Iron-Sulphur proteins (rubredoxins and ferredoxins) and cytochromes including cytochrome P450.

Iron and Copper containing redox enzymes: Catalase and peroxidase. Superoxide dismutase.

Zinc Containing enzymes: Alcohol dehydrogenase, carboxy peptidase A.

UNIT – III **16 Hours**

Therapeutic uses of some metals and ligands.

Metal complexes as drugs and therapeutic agents: Introduction, antimicrobial agents, antiviral agents, antiarthritis agents and anticancer agents.

Treatment of toxicity due to inorganics: Mechanism of

(i) Antidote complexes with poison, rendering it inert (heavy metals, iron, copper and thallium)
(ii) Antidote accelerated metabolic conversion of poison to non-toxic product (cyanide).
(iii) Antidote cometes with poison for essential receptors (carbon monoxide, morphine and morphine like narcotics).

UNIT – IV **16 Hours**

Homogeneous catalysis: Introduction, properties of catalysis, types of reactions in homogeneous catalysis, hydrogenation of olefins, isomerization of olefins, oxo-process, Wacker process, Monsanto acetic acid process, Monsanto L-Dopa synthesis, water gas shift reaction, carbonylation, template synthesis, alkene hydrosilation.

Heterogeneous Catalysis: Introduction, Fischer-Tropsch reaction, Ziegler-Natta catalysis.

Biological applications and Environmental aspects of organometallic compounds: Introduction, organometallics in medicine, agriculture and in horticulture, and environmental aspects of organometallic compounds.

REFERENCES:

1. Biochemistry – A. L. Lehninger
2. Biochemistry- L. Stryer
3. Bioinorganic Chemistry- R. W. Hay
4. The Inorganic chemistry of Biological Processes – 2nd edition, M. N. Hughes.
5. Bioinorganic Chemistry- M. Satake and Y. Mido.
6. Bioinorganic Chemistry- G. R. Chatwal and Ajaykumar Bhagi.
7. Biological aspects of Inorganic chemistry- A. W. Addison, W. R. Cullen, D Dolphin and B. R. James
8. Principles of drug action: The basis o pharmacology, 2nd edition- A. Goldstein, A. Aronow and S. M. Kalman.
9. Advanced Inorganic Chemistry- II- Gurdeep Raj.
10. Inorganic Chemistry- F. A. Cotton and G .Wilkinson (2nd edition)
11. Inorganic chemistry Principles and Structures- J. Huheey.
12. Organometallic Chemistry- R. C. Mehrothra and A. Singh
13. Fundamental Transition metal Organometallic Chemistry- Charles M. Lukehart.
14. Inorganic Chemistry-Purcell and Kotz

CPT – 4.2
Macromolecules, Photochemistry and Solid State chemistry.

UNIT – I 16 Hours

Chemistry of Macromolecules

Basic concepts: classification, nomenclature, molecular weights, molecular weight distribution, glass transition, degree of crystallinity, morphology, and viscosity-molecular weight, mechanical property - molecular weight relationships.

Molecular weights and Methods of determination, molecular weight distribution, size and shape of macromolecules. Intrinsic viscosity, Mark-Houwink relationship.

Chain structure and configuration, conformation, size of an ideal chain (freely jointed chain and other models), Real chains, Flory theory.

Thermodynamics of polymer solutions: Molecular motion (self-diffusion, hydrodynamic radius, Rouse Model, Zimm Model, entangled polymer dynamics and de Gennes reptation model).

Glass transition temperature – elementary theories and methods of determination. Variation of glass transition with structure.

Methods of Polymerization: Molecular weight distribution. Chain polymerization, controlled radical polymerizations (INIFERTER, ATRP, RAFT, SET).

Raman spectroscopy: Introduction, Raman and Rayleigh scattering, stokes and anti-stokes lines, polarization of Raman lines, depolarization factor, polarizability ellipsoid. Theories of Raman spectra –classical and quantum theory. Rotation, vibration and rotation-vibration Raman spectra. Comparison of Raman and IR spectra, rule of mutual exclusion principle. Advantages of Raman spectra. Molecular data bond length and vibration determined by Raman spectroscopy.

UNIT – II 16 Hours

Photochemistry: Introduction to photochemistry, quantum yield and its determination, factors affecting quantum yield, experimental technique in photochemistry, Actinometry- Uranyloxalate and potassium ferrioxalate actinometers, acetone and diethylketone actinometers.

Term symbols and significance. Photosensitization: by mercury, dissociation of H_2, sensitized isomerization. Photodimerization of anthracene, photochemical kinetics of: Decomposition of HI, CH_3CHO; formation of HCl, HBr and $COCl_2$; Chlorination of ZnO/TiO_2 in the photo degradation of dyes (IC), pesticides (DDT) and in industrial effluents. Effect of photodegradation on COD value.

Direct spectroscopic identification of primary processes, use of free radical traps in the determination of primary photodecomposition modes. Photophysical properties: Fluorescence, characteristics of fluorescence, resonance fluorescence, sensitized

fluorescence, quenching of fluorescence, phosphorescence, characteristics, chemiluminescence - theory and applications, photochemistry of vision.

UNIT – III **16 Hours**

Crystal Defects and Non-Stoichiometry: Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schotty defects and Frenkel defects, thermodynamics of Schotky and Frenkel defect formation, color centers, non-Stoichiometry and defects.

Electrical conductivity, origin of valence and conduction band in solids, classification of material, types of semiconductor, time dependent of conductivity, mobility of charge carriers, metal-metal junction, metal–semiconductor junction, Diodes, p-n junction, transistor, superconductors, superconductivity: superconductivity, BCS theory, superconductors—Meissner effect.

UNIT – IV **16 Hours**

Crystal geometry: Crystal system, lattices, Miller planes, crystal packing, symmetry elements for solids (including glide planes and screw axis). Introduction to space groups with examples.

X-ray diffraction: Fundamentals of X-ray crystallography, law of interfacial angles, laws of symmetry, X-ray diffraction, Bragg condition, miller indices, Laue method, Bragg method,

Debye-Scherrer method, rotating crystal method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction

pattern, structure of simple lattices and X-ray intensities, Atomic scattering factor, structure,

structure factor and its relation to intensity and electron density, Fourier synthesis, phase problem, description of the procedure for an X-ray structure analysis,

Electron diffraction of gases. Experimental technique, Scattering -Intensity curves, Wierl equation (no derivation), Radial distribution method, Determination of bond lengths and bond angles.

Neutron diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurement, techniques, elucidation of structure of magnetically ordered unit cell.

REFERENCES:

1. Advances in Photochemistry - Rohatgi Mukherjee.
2. Principles and applications of Photochemistry - R.P. Wayne, Elsevier, New York., 1970.
3. Dupey and Chapmann, Molecular reactions and photochemistry, Prentice Hall - International, Tokyo, 1972.

4. N. J. Turro, Modern molecular photochemistry, The Benzamin Cummings Publishing Co. Ltd. Menlo Park, 1978.
5. Introduction to X-ray crystallography- Azaroff
6. X-ray crystallography – Buerger, M.J. John Wiley and sons.
7. A. R. West. Solid State Chemistry and its Applications, John Wiley (1990).
8. R. J. Young and P. A. Lovell, Introduction to Polymers, 2nd Edition, Chapman and Hall, 2002.
9. F. W. Billmeyer, Textbook of Polymer Science, 3rd Edition, John Wiley, 1994.
10. V. R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd, 2005.
11. G. Odian, Principles of Polymerization, Fourth edition, Wiley-Interscience, 2004.
12. L. H. Sperling, Introduction to Physical Polymer Science, Wiley- Interscience, 1986.
13. M. Rubinstein and R. A. Colby, Polymer Physics, Oxford University Press, 2003.
14. A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)
15. J H Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972)
16. J. D. Lee, Concise Inorganic Chemistry, Elbs with Chapman and Hall, London
17. A. R. West, Plenum, Solid State Chemistry and its applications
18. N. B. Hanney, Solid State Physics
19. H. V. Keer, Principles of Solid State
20. S. O. Pillai, Solid State Physics
21. W. D. Callister, Wiley, Material Science and Engineering: An Introduction
22. A. R. West, Basic Solid State Chemistry, 2nd edition
23. U. Schubest and N. Husing, Synthesis of Inorganic Materials, Wiley VCH (2000)
24. Physical Chemistry, Gordon M. Barrow, Mcgraw-Hill College; 6 Sub edition (March 1, 1996)

SPT – 4.3.A
Chemistry of Natural Products

UNIT – I 16 Hours

Carbohydrates: Introduction, Ring size determination of monosaccharides, Configuration and conformation of monosaccharides, anomeric effect, Hudsons rule, epimerization and mutarotation. Chemistry of important derivatives of monosaccharides-, carboxylic acids, dihydrosugars,deoxysugars, cyclitols, aminosugars and anhydrosugars., Isolation, Importence, synthesis and Structure elucidation of disaccharides- sucrose, maltose, cellobiose General methods of structural degradation of polysaccharides-methylation, partial hydrolysis, periodate oxidation, Smith degradation and alkaline degradation techniques. Structure and importance of cellulose, chitin, starch and glycogen. Separation of carbohydrates by TLC, HPLC and GLC methods.

UNIT – II 16 Hours

Steroids: Introduction, Nomenclature, configuration of substitutents,Abosute configuration in the ring, configuration in the side chain, conformation of A/B,B/C and C/D rings. Improtance, and synthesis of cholesterol. Stucure and biological importance of Estrone, progesterone, testosterone, androsterone and carticosterone. Biosynthesis of cholesterol.Oral contraceptives.

Alkaloids: Introduction, classification. Isolation and general methods of structural elucidation. Biological importance of alkaloids. Structure and synthesis of qunine, morphine, reserpine.

UNIT – III 16 Hours

Lipids: Nomenclature, occurrence of triglycerides,classification, purification, reactions of fatty acids, structure and synthesis of lipids, phospholipids, sphingolipids. Biological importance of lipids: Lecithin, sphingolipids, oils and fats.

Prostaglandins: Introduction, classification and biological importance and mode of action of prostaglandins in biological system. Constitution of PGE1. Synthesis of PGE & F series.

Enzymes: Introduction, nomenclature, classification, General characteristics, Theories of interaction : lock and key model, Koshland induced-fit theory , Coenzymes: coenzyme role of theanine, Riboflavin, Pantothenic acid. Mode action of enzymes in catalyzing the reaction (Chymotrypsin, Ribonuclease, Lysozyme) with examples and their functions.

UNIT – IV 16 Hours

Terpenoids: Introduction, classification and general methods of structural elucidation. Biological importance of terpenoids. Structure elucidation, synthesis and imprtence of of pinene, camphor. Santonin, β-caryophyllene.

Anthocyanins: Introduction, general nature of anthocyanin. Structure and synthesis of anthocyanidins, Flavones and isoflavones.

Porphyrins: Introduction, structure and synthesis of haemin. Vitamin B12 structure and as coenzyme in molecular rearrangement reactions: Chlorophyll: structure and biological importance.

Pheromones: introduction, classification, source and uses. Synthesis of grandisol, brevicomin and bombykol.

REFERENCES:

1. O.L. Chapman, Organic Photochemistry. Vol I & II. Marcel Decker.
2. Francis A Carey and R. J. Sundberg, Advanced Organic Chemistry-Part A & (Plenum).
3. Mukherji Singh and Kapoor , Organic Chemistry, Vol 1-3, (Wiley Eastern, New Delhi)
4. Synthetic Organic Chemistry- G.R.Chatwal (Himalaya, Bombay), 1994.
5. Organic Reaction Mechanisms , V.K. Ahluwalia & R.K.Parashar (Narosa) 2006
6. Organic Chemistry, Vol I-II, I.L.Finar,(Longmann ELBS, London), 1973.
7. Advanced Organic Chemistry- Reaction Mechanisms, Reinhard Bruckner(Academic) 2005.
8. Pericyclic reactions, S.M Mukherji(The McMillan Bangalore), 1979.
9. Organic Reactions and their mechanisms- P.S.Kalsi (New Age, New Delhi), 1996.
10. I. L finar, Organic chemistry, ELBS Longman, Vol I & II, 11984.
11. Harper's Biochemistry, Ed. R. Harper, 22ndedition, prentice Hal Press, New York, 1990.
12. Encyclopedia of Chemicl technology-Kirck-Othmer series.
13. Introduction to alkaloids, G. W Swan.

SPT – 4.3.B
Medicinal chemistry

UNIT – I **16 Hours**

Introduction: Characteristics of drug-Prodrug – biotransformation of drugs- Routes of drug administration, Dosage forms, drug binding, drug toxicity, drug addiction, development of synthetic drugs, Some important terms used in chemistry of drugs, Medicinal chemistry, Pharmacy, Pharmacology, molecular pharmacology, Pharmacodynamics, Pharmacophore, Pharmacodynamic agents, Antimetabolites-Bacteria, Types of bacteria, Virus, Fungi, Antinomy cites, Mutation

UNIT – II **16 Hours**

Classification and Nomenclature of drugs: Importance and Classification of drugs based on the chemical- Analgesics, Antipyretics, Antacids or gastrointestinal agents, sulpha drugs, Antibiotics, Antimalarials, Antidepressents, Antihistamines, Antiinflammatory agents, cardiovascular agents, Diuretic agents, Drugs acting on central nervous system, Nonselective central nervous system depressant, Selective modifiers of central nervous system, Central nervous system stimulants, Drugs stimulating or blocking peripheral nervous system.

Nomenclature of the drugs: Introduction, Naming of organic groups, Stereo chemical notations, DL desecrators-Cahn Ingold Prelog convention- R and S configuration- Rules for priority – E and Z isomerism.

UNIT – III **16 Hours**

Chemistry of drug action: History of drug discovery and developments: Historical outline, Pharmacodynamics vs. Chemotherapeutic drugs, Accomplishment and challenges in drug development,

Sources of drugs: Natural products, Drugs from organic synthesis, drug discovery and developments

Drug structure and biological activity: Pharmaceutically important functional groups, Physiochemical properties of drugs, Electronic effects, spatial properties of drugs

Fate of drugs in the body: Absorption, distribution, metabolism, Excretion (ADME), Chemistry of drug metabolism, Modification to decrease metabolism, prodrugs

Molecular mechanism of drug action: Drug targets, Receptors, Enzymes, Nucleic acids, non-receptor targets.

UNIT – IV **16 Hours**

Synthesis of selected class of drug and their mode of action: Anti-bacterial – Sulphamethizole, Sulfasalazine. Analgesics and Anti-inflammatory – Aspirin, Phenacetin. Antibiotics – Benzylpenicilline, Chloromycetin. Hypnotics and Sedatives –

Phenobarbital, Chlorodiazopoxide. Antineoplastics – 5-Fluorouracil, Chloroambucil. Cardiovascular agents – Propanolol, Timolol.

REFERENCES:

1. Burgers medicinal chemistry M. E. Welly Medicinal Chemistry M.E. Walffed John willey and sons, Vo 1, 2 and 3.
2. Wilson and Giswold's, Text Book of Organic and Medicinal Chemistry.
3. William. O. Foye, Princiles of Medicinal chemistry, Lea amd Febiger, Philadelphia.
4. Martindale, the extra pharmacopoeia, J.E. Reynolds. The Pharmaceuticals Press, London.
5. A. M. Beckett and J.B. Stanlake and Garrel, Practical Pharmaceutical chemistry, the Sthalone Press, University of London, London.
6. I. P 85 and 96, Govt. of India, Ministry of India.
7. B.D. Furniss, A.J. Hannaford, V.Regers, P.W.G. Smith and A.R. Tachell, Vogels textbook of practical organic chemistry, including quantitative analysis ELBS Longman, London.
8. J.G.Mann and S.C.Saunders, Practical organic chemistry, Longmann Green and Co. Ltd.,London.
9. Organic drug synthesis-LediserMitzsher Vol. 1 and 2.
10. Current index of medical specialties (CIMS).

CPD: 4.4

Core Paper Dissertation **64 Hours**

CPP 4.5 (4.1)

Practical Inorganic Chemistry - 4

64 Hours

1. Preparation of any Four of the following complexes and determination of the purity of the prepared sample and structural study of the prepared complexes using physical methods such as magnetic susceptibility measurements, absorption spectra etc.
    a) Chloropentaammine Cobalt (III) Chloride
    b) nitropentaammine Cobalt (III) Chloride
    c) nitritopentaammine Cobalt (III) Chloride
    d) Hexamine Cobalt (III) Chloride
    e) mercury tetrathiocyanato cobaltate (II)
    f) Hexemine nickel (II) chloride
    g) tris –(thiourea) copper (I) sulphate
    h) Potassium tris (Oxalato) ferrate (III)
2. Determination of ionisable chloride by ion exchange method.
3. Stabilization of an unstable oxidation state by complexation: Preparation of Manganese (III) acetyl acetonate
4. Preparation of EDTA complex of Mn (III).
5. Determination of the composition of a complex of iron-phenanthroline by
    a) Mole -ratio method
    b) Job's method
    c) Slope ratio method
6. Determination of the stability constant of a complex
    a) Turner-Aderson method (iron-T iron or iron-phenanthroline complex)
    b) Bjerrum's method (copper sulphosalicylic acid)
    c) Kinetic method (KI_3 complex)
7. Preparation and kinetics of the acid hydrolysis of potassium trisoxalato cobaltate (III) trihydrate
8. Preparation and photolysis of potassium trisoxalatoferrate(III).
9. Preparation and screening of copper complex for its fungicidal and bactericidal activity.
10. 10 Demonstration Experiments
    a) Recording and interpretation of IR and NMR spectra of complexes
    b) Interpretation of a simple x-ray powder photograph
    c) TGA of calcium Oxalate monohydrate
    d) DTA studies of copper sulphate penta hydrate
    c) Spectrochemical series- evaluation of Dq value.

REFERENCES:

1. A Text Book of quantitative Inorganic Analysis- 5th edition- A. I. Vogel.
2. Experimental inorganic chemistry- G. Palmer
3. Inorganic synthesis- O. Glemser.
4. Experimental Inorganic/Physical chemistry- Mounir A. Malati.
5. Instrumental analysis manual- Modern experiments for Laboratory- G G. Guilbault and L.G. Hargis

CPP 4.6 (4.2)

Practical Physical Chemistry – 4

64 Hours

1. Determine the quantum yield of chloride ion during the photohydrolysis of an aqueous solution of monochloroacetic acid by light of different wavelengths
2. Determine the limiting viscosity number of polymer
3. Determine the chain linkage in poly(vinyl alcohol) from viscosity measurement
4. Determination of the molecular weight of a polymer material by viscosity measurements (polyvinyl alcohol / polystyrene / cellulose acetate / methyl acrylate).
5. Determine the relative molecular mass of hydroxyl terminated polybutadine and carboxyl terminated polybutadiene
6. Compare the powder diffraction photograph of potassium chloride and compare with that of sodium chloride and ii) to calculate λ and d from the diffraction photograph.
7. Study the complex formation and find the formula of silver-ammonia complex by distribution method.
8. Construct a chemical actinometry and determine the quantum yield and calibrate the lamp intensity using $K_3[Fe(C_2O_4)_3]$ $3H_2O$ as reference compound.
9. Photolysis of CAT solution - determination of quantum yield and study of kinetics of photodecomposition.
10. To study the variation of volume contraction with mole fraction of alcohol in alcohol -water system
11. Photo decomposition of HI and determination of its quantum yield.
12. Determine the density of solids and comparion with the X-ray diffraction pattern data
13. Crystal structure analyses using XRD a) simple cubic structure, b) fcc structure, c) hexagonal structure and d) tetragonal structure
14. X-ray diffraction method-Indexing and unit cell paramaters determination
15. Photodegradation of dyes using inorganic oxides and their kinetics
16. Interpretation of UV-Visible spectra of simple organic/inorganic compounds

REFERENCES:

1. Textbook of polymer science: F.W. Billmayer Jr. Wiley.
2. Polymer science: V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.
3. Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.
4. Contemporaty polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.
5. Principles of polymer Chemistry: Flory, Cornell Univ. press.
6. Introduction to polymer chemistry: R. B. Seymour, McGraw Hill.
7. Principles of polymerization: Odian.
8. A first course in polymer chemistry: A. Strepikheyew, V. Derevistkay and G. Slonimasky, Mir Publishers, Moscow.
9. Laboratory preparation of macro chemistry: EMM effery, McGraw Hill Co.
10. A practical course in polymer chemistry: S.J. Punea , Pergamon Press.
11. Practical Physical chemistry – A.J. Findlay.
12. Experimental Physical Chemistry – F. Daniels et al.
13. Selected Experiments in Physical Chemistry – Latham.
14. Experiments in Physical Chemistry – James and Prichard.
15. Experiments in Physical Chemistry – Shoemaker.

16. Advanced Physico – Chemical experiments – J. Rose.
17. Practical Physical Chemistry. - S.R. Palit.
18. Experimental physical chemistry, R. C. Das and B. Behera, Tata McGraw-Hill Publishing Company Limited, 1983.
19. Experimental Physical Chemistry, V. D. Athawale and Parul Mathur, New Age International (p) Limited, Publishers, New Delhi, 2001.

SPP - 4.7 (4.3.A)
Practical Organic Chemistry

PART-I **64 Hours**

Quantitative determination of sugars, amino acids, phenols, carboxylic acids, amides, esters, aldehydes, ketones, urea by various methods. Determinations of acid and ester and acid and amide in mixtures of two.

PART-II

1. Isolation of piperine from pepper
2. Isolation of caffeine from tea
3. Isolation of cysteine from hair
4. Isolation of hesperidiene from orange peal
5. Isolation of azaleic acid from castor oil
6. Isolation and spectroscopic characterization of Lycopene
7. Isolation of lipids from egg yolks
8. Extraction of nicotine from tobacco leaves

REFERENCES

1. A text book of practical organic chemistry – AI Vogel Vol I
2. Practical organic chemistry –Mann &Saunders
3. Manual of organic chemistry – Dey and Seetharaman
4. An introduction to practical organic chemistry – Robert, Vingrove etc.
5. Semimicro qualitative organic analysis by Cheronis, Entrikin and holdnet
6. J.N. Guthru & R. Kapoor, Advanced experimental chemistry, S. Chand Company, new Delhi, 1991.
7. R. K. Bansal, laboratory Manual of Organic chemistry, New PGE International (P) Ltd. London, 3rd edition, 1996.
8. N. K. Visno, Practical organic chemistry, New PGE International (P) Ltd. London, 3rd edition, 1996.

SPP 4.7 (4.3.B)
Practical Organic Chemistry

Part I **64 Hours**

Assay of medicinally useful compounds

1. Ibuprofen by alkalimetry.
2. Diclofenac by alkalimetry.
3. Analgin by iodimetry.
4. Epherdrine hydrochloride by non-aqueous titration.
5. Phenobarbitone sodium by non- aqueous titration.
6. Procaine/Benzocaine by diazotization.
7. Chlorpromazine by Cerrimetry.

Part II

Preparation of medicinally useful compounds

1. Phenytoin from benzoin.
2. Paracetamol form p-nitro phenol.
3. Benzocaine from [-amino benzoic acid.
4. 4-hydroxy coumarin from resorcinol.
5. Mefenamic acid from anthranilic acid.

REFERENCE:

1. Indian Pharmacopia.1985.
2. I.L. Finar, Text Book of Organic Chemistry.
3. Lednicer Mitzsher, the Organic Chemistry of drug synthesis, vol 1, and 2.
4. A text book of practical organic chemistry – AI Vogel Vol I
5. J. G. Mann and Saunders, Practical organic chemistry.
6. T. Robinsom, Organic constituents of higher medicinal plants.

CPDP: 4.8

Core Paper Dissertation Practical

32 Hours

Sd/-
Chairman
BOS in Chemistry