

UNIVERSITY OF RAJASTHAN,
JAIPUR

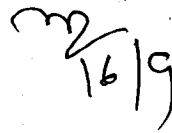
M.A./M.SC./M.COM

(~~CHEMISTRY~~)

2013-2014 (PREVIOUS)-I/II SEMESTER

2014-2015 (FINAL)- III/IV SEMESTER

Prepared by


16/9

Checked by


24/9

5.7	85	3.7	57	1.7	35.4
5.6	80	3.6	56	1.6	34.2
5.5	75	3.5	55	1.5	33
5.4	74	3.4	54	1.4	32.2
5.3	73	3.3	53	1.3	31.4
5.2	72	3.2	52	1.2	30.6
5.1	71	3.1	51	1.1	29.8
5	70	3	50	1	29
4.9	69	2.9	49	0.9	28.2
4.8	68	2.8	48	0.8	27.4
4.7	67	2.7	47	0.7	26.6
4.6	66	2.6	46	0.6	25.8
4.5	65	2.5	45	0.5	25
4.4	64	2.4	43.8	0.4	20
4.3	63	2.3	42.6	0.3	15
4.2	62	2.2	41.4	0.2	10
4.1	61	2.1	40.2	0.1	5

The enhancement of CGPA by 0.01 will enhance percentage as given below:

Grade	SGPA or CGPA	Percentage enhancement on 0.01 CGPA enhancement
O	5.50 to 6.00	0.5
A	4.50 to 5.49	0.1
B	3.50 to 4.49	0.1
C	2.50 to 3.49	0.1
D	1.50 to 2.49	0.12
E	0.50 to 1.49	0.08
F	0.00 to 0.49	0.5

For example (i) CGPA of 5.73 is equivalent to 86.5%, (ii) CGPA of 5.12 is equivalent to 71.2%, (iii) CGPA of 4.34 is equivalent to 63.4%, (iv) CGPA of 3.26 is equivalent to 52.6%, (v) CGPA of 2.17 is equivalent to 41.04%, and (vi) CGPA of 1.11 is equivalent to 29.88%.

2. Eligibility:

A candidate who has secured more than 55% or CGPA of 3.5 in the UGC Seven Point scale [36% or Pass marks for SC/ST/Non-creamy layer OBC/SBC] or equivalent in the Bachelor degree in Science or Engineering or Technology or Medicine or Pharmaceutical Science shall be eligible for admission to First Semester of a Master of Science course. For candidates from outside state of Rajasthan 60% or CGPA of 4.0 in the UGC Seven Point Scale will be applicable irrespective of the category.

3. Scheme of Examination:

- (1) Each theory paper EoSE shall carry 100 marks The EoSE will be of 3 hours duration. Part 'A' of theory paper shall contain 10 Short Answer Questions of 20 marks, based on knowledge, understanding and applications of the topics/texts covered in the syllabus. Each question will carry two mark for correct answer.

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- (2) Part "B" of paper will consist of Four questions with internal choice (except in cases where a different scheme is specifically specified in the syllabus) of 20 mark each. The limit of answer will be five pages.
- (3) Each Laboratory EoSE will be of four/six hour durations and involve laboratory experiments/exercises, and viva-voce examination with weightage in ratio of 75:25.
- (4) The Practical examination will be conducted by board of examiners consisting of one internal (to be appointed by the Head of Department) & one external examiner (to be appointed by the University).

4. Course Structure:

The details of the courses with code, title and the credits assign are as given below.

Abbreviations Used

Course Category

CCC: Compulsory Core Course

ECC: Elective Core Course

OEC: Open Elective Course

SC: Supportive Course

SSC: Self Study Core Course

SEM: Seminar

PRJ: Project Work

RP: Research Publication

Contact Hours

L: Lecture

T: Tutorial

P: Practical or Other

S: Self Study

Relative Weights

IA: Internal Assessment (Attendance/Classroom Participation/Quiz/Home Assignment etc.)

ST: Sessional Test

EoSE: End of Semester Examination

First Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	CHY 101	Inorganic Chemistry	CCC	4	3	1	0	3	0

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2.	CHY 102	Organic Chemistry	CCC	4	3	1	0	3	0
3.	CHY 103	Physical Chemistry	CCC	4	3	1	0	3	0
4.	CHY 104	Mathematics/Biology for Chemists	CCC	4	3	1	0	3	0
5.	CHY 105	Spectroscopy-I	CCC	4	3	1	0	3	0
6.	CHY 106	Bio-Inorganic Chemistry	CCC	4	3	1	0	3	0
7.	CHY 111	Practical A- Inorganic Chemistry	CCC	4	0	0	6	0	4
8.	CHY 112	Practical B - Organic Chemistry	CCC	4	0	0	6	0	4
9.	CHY 113	Practical C - Physical Chemistry	CCC	4	0	0	6	0	4

Second Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	CHY 201	Inorganic Chemistry	CCC	4	3	1	0	3	0
2.	CHY 202	Organic Chemistry	CCC	4	3	1	0	3	0
3.	CHY 203	Physical Chemistry	CCC	4	3	1	0	3	0
4.	CHY 204	Spectroscopy-II	CCC	4	3	1	0	3	0
5.	CHY 205	Bio-Organic Chemistry	CCC	4	3	1	0	3	0
6.	CHY 206	Environmental Chemistry	CCC	4	3	1	0	3	0
7.	CHY 211	Practical A- Inorganic Chemistry	CCC	4	0	0	6	0	4
8.	CHY 212	Practical B - Organic Chemistry	CCC	4	0	0	6	0	4
9.	CHY 213	Practical C - Physical Chemistry	CCC	4	0	0	6	0	4

Third Semester

S.	S. No.	Course Title	Category	Credit	Contact	EoSE
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No.					Hours Per week			Duration (Hrs.)	
					L	T	P	Thy	P
1.	CHY 301	Inorganic Materials & Nanotechnology	CCC	4	3	1	0	3	0
2.	CHY 302	Green Chemistry	CCC	4	3	1	0	3	0
3.	CHY 303	Bio-Physical Chemistry	CCC	4	3	1	0	3	0
4.		Core Elective - 1	ECC	4	3	1	0	3	0
5.		Core Elective - 2	ECC	4	3	1	0	3	0
6.		Core Elective - 3	ECC	4	3	1	0	3	0
7.	CHY 311	Practical A- Inorganic Chemistry	CCC	4	0	0	6	0	4
8.	CHY 312	Practical B - Organic Chemistry	CCC	4	0	0	6	0	4
9.	CHY 313	Practical C - Physical Chemistry	CCC	4	0	0	6	0	4

Fourth Semester

S. No.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per week			EoS Exam. Duration (Hrs.)	
					L	T	P	Thy	P
1.		Core Elective - 4	ECC	4	3	1	0	3	0
2.		Core Elective - 5	ECC	4	3	3	0	3	0
3.		Core Elective - 6	ECC	4	3	3	0	3	0
4.	CHY 424	Seminar		4	0	0	6	0	4
5.	MTM 425	Project Work in Industry Or Institution or University (15 week)	PW	20	0	0	30	0	4

ELECTIVE CORE COURSES

Specialization Clusters

A. Inorganic Chemistry

B. Organic Chemistry

C. Physical Chemistry

Elective Course Code	Specialization	Paper Title	Prerequisite	Semester

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CHY A01	ECC	Photo –Inorganic Chemistry		III
CHY A02	ECC	Organo-transition metal Chemistry		III
CHY A03	ECC	Superamolecular Chemistry		III
CHY A04	ECC	Inorganic Polymers	CHY A01	IV
CHY A05	ECC	Advance Bio Inorganic Chemistry	CHY A02	IV
CHY A06	ECC	Mineral Based Industrial Chemistry	CHY A03	IV
CHY B01	ECC	Natural Products - I		III
CHY B02	ECC	Organic Synthesis - I		III
CHY B03	ECC	Heterocyclic Chemistry - I		III
CHY B04	ECC	Natural Products – II	CHY B01	IV
CHY B05	ECC	Organic Synthesis – II	CHY B02	IV
CHY B06	ECC	Heterocyclic Chemistry – II	CHY B03	IV
CHY C01	ECC	Electroanalytical Techniques		III
CHY C02	ECC	Electrochemistry - I		III
CHY C03	ECC	Chemical Kinetics		III
CHY C04	ECC	Chemical Analysis	CHY C01	IV
CHY C05	ECC	Electrochemistry-II	CHY C02	IV
CHY C06	ECC	Chemical Kinetics-II	CHY C03	IV

Note :

CHY 101: INORGANIC CHEMISTRY

UNIT - I

Stereochemistry and Bonding in Main Group Compounds:

Limitations of VSEPR Theory, Walsh diagram (triatomic (AH₂ type) and tetra-atomic (AH₃) molecules), dπ-pπ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

UNIT - II

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Metal-Ligand bonding:

Limitation of crystal field theory, molecular orbital theory, and introduction to ligand field theory; octahedral, tetrahedral and square planar complexes, π -bonding and molecular orbital theory.

UNIT - III

Chemistry of Lanthanides, Actinides and Super Heavy elements:

Chemistry of lanthanides and actinides, stable oxidation states; lanthanide and actinide contraction, absorption spectra of lanthanides and actinides and their magnetic properties, separation of lanthanides and actinides, uses of lanthanides and their compounds; chemistry of super heavy elements

UNIT - IV

Inorganic Reaction Mechanisms

Mechanisms of substitution reactions of tetrahedral, square planar, trigonal bipyramidal, square pyramidal and octahedral complexes; potential energy diagrams, transition states and intermediates, isotope effects, Berry's pseudo rotation mechanism, factors affecting the reactivity of square planar complexes, Swain-Scott equation, Trans effect and its applications to synthesis of complexes.

SUGGESTED BOOKS AND REFERENCES

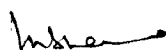
1. Inorganic Chemistry, Principles of Structure and Reactivity, 4th Edition; James E. Huheey; Ellet A. Keiter; Richard L. Keiter.
2. Advanced Inorganic Chemistry; F.A. Cotton and G. Wilkinson.
3. Theoretical Inorganic Chemistry; Day and Selbin.
4. Concepts and Models in Inorganic Chemistry; Douglas Mc Daniel.
5. Chemistry of Lanthanides; T. Healler, Chapman and Hall.
6. Chemistry of the Elements; N.N. Greenwood and A. Earnshaw, Pergamon, 1984.
7. Inorganic Electronic Spectroscopy; A.B.P. Lever, Elsevier, 1968.
8. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon, 1987; Vol. 2.

CHY 102: ORGANIC CHEMISTRY

UNIT - I

Reaction Mechanism: Structure and Reactivity

A review of types of mechanisms and reactions, methods of determining mechanisms, thermodynamic and kinetic requirements for reaction, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett Principle, Isotope effects. Effects of structure on reactivity, resonance and field effects, steric effects, quantitative treatments of the effect of



structure on reactivity. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation.

Aromaticity

Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level and non-alternant hydrocarbons. Huckel's rule, energy level of π - molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity, PMO approach, energetic and magnetic concept.

UNIT - II

Aliphatic Nucleophilic Substitution

The SN₂, SN₁, mixed SN₁ and SN₂ and SET mechanisms. The S_Ni mechanism. The neighbouring group mechanism, neighbouring group participation by σ and π bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system. Application of NMR spectroscopy in the detection of carbocations. Nucleophilic substitution at the allylic, aliphatic trigonal and a vinylic carbon.

Reactivity, the effect of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

Aromatic Nucleophilic Substitution

The S_NAr, SN₁, benzyne and SRN₁ mechanisms, Reactivity, effect of substrate structure, leaving group and attacking nucleophile. The Von Richte, Sommelet-Hauser and Smiles rearrangements.

UNIT - III

Aliphatic Electrophilic Substitution

Bimolecular mechanisms-SE₂ and SE_i, The SE₁ mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and solvent polarity on reactivity.

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeier reaction, Gattermann - Koch reaction.

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.



UNIT - IV

Addition to Carbon - Carbon Multiple Bonds

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

Addition to Carbon - Hetero Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates - Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Elimination Reactions

The E2, E1 and E1cB mechanisms and their spectrum. Steric orientation of the double bond. Reactivity, effects of substrate structure, the attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic eliminations.

CHY 103: PHYSICAL CHEMISTRY

UNIT - I

Quantum Chemistry

A. Introduction to Exact Quantum Mechanical Results

The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

B. Approximate Methods

The variation theorem, linear variation principle, Perturbation theory (First order and nondegenerate) Applications of variation method and perturbation theory to Helium atom.

UNIT - II

Quantum Chemistry

A. Angular Momentum

Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen values of angular momentum, operator using ladder operators, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

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B. Molecular Orbital theory

Huckel theory of conjugated systems, bond order and charge density Calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc, Introduction to extended Huckel theory.

UNIT - III

Surface Chemistry

A. Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomenon)

B. Micelles

Surface active agents, classification of surface active agents, micellization, hydrophobic interaction critical micellar concentration (CMC) factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, micro emulsion. reverse micelles.

UNIT - IV

Electrochemistry

Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces, Guoy-Chapman, Stern, Graham Devanatham-Mottwatts, Tobin, Bockris, Devanathan models, Over potentials, exchange current density, derivation of Butler Volmer equation, Tafel plot.

Polarography theory, Ilkovic equation; half wave potential and its significance.

SUGGESTED BOOKS AND REFERENCES

1. Physical chemistry , P.W. Atkins, ELBS.
2. Introduction to quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry. Ira N. Levine, Prentice Hall.
4. Quantum Chemistry by R.K. Prasad, new age international
5. Micelles, Theoretical and Applied aspects by V. Morai, Plenum Press.
6. Modern Electrochemistry Vol. I & II By J.O. M. Bockris and A.K.N. Reddy Plerum Press. New york.
7. Physical chemistry by Puri, Sharma and Pathania Vishal Publications.

W. S. R.

CHY 104: MATHEMATICS FOR CHEMISTS

(For students without Mathematics in B.Sc.)

UNIT - I

Matrix Algebra

Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric Skew-symmetric, Hermitian, skew-Hermitian, unit, diagonal, unitary etc.) and their properties. Matrix equations : Homogenous, non Homogenous, linear equations and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigenvalues and eigenvectors, diagonalization, determinants (examples from Huckle theory)

UNIT - II

Differential calculus

Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (example related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc)

UNIT - III

Integral calculus, basic rules for integration, integration by parts, partial fraction and substitution. Reduction formulae, applications of Integral calculus.

Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar).

UNIT - IV

Elementary Differential equations and Vectors

(a) Elementary Differential equations:

First-order and first degree differential equations, homogenous exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc. second order differential equations and their solutions.

(b) Vectors:

Vectors, dot, cross and triple products etc. gradient, divergence and curl. Vector calculus.

SUGGESTED BOOKS AND REFERENCES

1. The Chemistry Mathematics Book, E. Steiner, Oxford University Press.
2. Mathematics for Chemistry, Doggett and Suicliffe, Longman.
3. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
4. Chemical Mathematics, D.M. Hirest, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Barante, Prentice Hall.
6. Basic Mathematics for Chemist, Tebbutt, Willey.

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CHY 106: BIOLOGY FOR CHEMISTS

(For students without Biology in B.Sc.)

UNIT -I

Cell Structure and Functions

Structure prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plants and animal cells. Overview of metabolic process - catabolism and anabolism. ATP- the biological energy currency. Origin of life unique properties of carbon, chemical evolution and rise of living systems, Introduction to biomolecules, building blocks of bio-macromolecules.

UNIT -II

Carbohydrates

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides like glycoside, deoxysugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides-cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances, Ascorbic acid.

Carbohydrates metabolism- Krebs cycle, glycolysis, gluconeogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway.

UNIT -III

Lipids

Fatty acids, essential fatty acids, structure and functions of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins- composition and function, role in atherosclerosis.

Properties of Lipids aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure.

Lipid metabolism - β -oxidation of fatty acids.



UNIT -IV

Proteins and Nucleic acid

Structure of proteins- α -helix, β -sheets, super secondary structure. Triple helix structure of collagen. Tertiary structure of Protein-folding and domain structure. Quaternary structure of proteins

Nucleic Acids

Purine and pyrimidine bases of nucleic acids, base pairing via hydrogen bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code, chemical synthesis of mono and tri nucleosides.

SUGGESTED BOOKS AND REFERENCES

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers. 2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Peterson.
4. Biochemistry, Voet and Voet, John Willey.
5. Outlines of Biochemistry, E.E. Conn and P.K. Stumpf, John Willey.

CHY 105: SPECTROSCOPY -I

UNIT - I

A. Microwave Spectroscopy

Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor; Stark effect, nuclear and electron spin interaction and effect of external field applications.

B. Vibrational Spectroscopy

Vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy. P.Q.R. branches, breakdown of Oppenheimer approximation; vibrations of polyatomic molecules; selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations.

UNIT - II

Electronic Spectroscopy

A. Atomic Spectroscopy

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Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms.

B. Molecular Spectroscopy

Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

C. Photoelectron Spectroscopy

Photo-electric effect, ionization process, Koopman's theorem, photoelectron spectra of simple molecules, ESCA, chemical information from ESCA; Auger electron spectroscopy-basic idea.

UNIT - III

Nuclear Magnetic Resonance Spectroscopy

Nuclear spin quantum number, I , and its calculation using the nuclear shell model, spin parity rule. Types of nuclei based on value of I , nuclear spin angular momentum, quantum number and its relation to classical magnetic moment. Application of chemical shifts, signal intensities and spin-spin coupling to structure determination of inorganic compounds carrying NMR active nuclei like ^1H , ^{11}B , ^{15}N , ^{19}F , ^{29}Si , ^{31}P , ^{183}W , ^{195}Pt , ^{119}Sn etc., NMR of paramagnetic substances in solution, the contact and pseudo contact shifts, factors affecting nuclear relaxation, some applications including biochemical systems.

UNIT - IV

A. Electron Spin Resonance Spectroscopy

Basic principles, zero field splitting and Kramer's degeneracy, Isotropic and anisotropic Hyperfine coupling, spin-orbit coupling and significance of g -tensors, factors affecting the 'g' value, application to transition metal complexes; spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques and applications, spin polarization for atoms and transition metal ions.

B. Mossbauer Spectroscopy

Basic principles, spectral parameters and spectrum display, applications of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin. (2) Sn^{+2} and Sn^{+4} compounds, nature of M-L bond, coordination number, structure and (3) detection of oxidation state and inequivalent MB atoms.

SUGGESTED BOOKS AND REFERENCES

1. Modern Spectroscopy, J.M. Hollas, John Wiley.

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2. Applied Electron Spectroscopy for Chemical Analysis D. H. Windawi and F.L. Ho, Wiley Interscience.
3. NMR, NQR, EPr and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Chemical Applications of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill.
7. Electronic Absorption Spectroscopy and related Techniques, D N Sathyanarayana
8. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.
9. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.
10. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
11. Introduction to Magnetic Resonance. A Carrington and A.D. Maclachalan, Harper & Row.

CHY 106 - BIOINORGANIC CHEMISTRY

UNIT - I

Metals in Life Processes:

Role of metal ions in biological systems: essential and non-essential elements- macro minerals and essential trace elements- synergism and antagonism among essential trace elements: active transport of Na, K, Mg and Ca ions across the biological membrane; elements of bioenergetics with special reference to elements of high energy phosphate bond.

UNIT - II

Electron Carriers and Photosynthesis:

(a) Electron transfer in biology: Structure and functions of electron transfer proteins. Cytochromes and respiratory chain, iron-sulphur proteins rubredoxin and ferridoxins. Synthetic models for Fe_4S_4 cluster only.

(b) Photosynthetic pigments: Photochemistry of chlorophyll molecules, mechanism of photosynthesis, Calvin cycle and Quantum efficiency. Function of photosystem- I and photosystem-II. Cyclic and non-cyclic phototphosphorylation.

UNIT - III

Transport and Storage of Dioxygen:

Heam proteins and oxygen uptake. Structure and function of haemoglobin, myoglobin. Structural model for dioxygen binding-co-operativity, Perutz mechanism and Bohr effect; non-haem oxygen carriers in some lower animals, haemocyanin and haemerythrin. Model synthetic complexes of iron, cobalt and copper.

UNIT - IV

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Nitrogen Fixation:

Nitrogen in biosphere, nitrogen cycle, nitrification role microorganism, nitrogen fixation in soils. Biological nitrogen fixation and its mechanism, nitrogenase, Chemical nitrogen fixation and other nitrogenase model systems.

SUGGESTED BOOKS AND REFERENCES

1. Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Berg, University Science Books.
2. Bioinorganic Chemistry, 1, Bertini, H. B. Gray, S. J. Lippard and J. S. Valentine, University Science Books.
3. Bio-organic, Bio-inorganic and Supramolecular Chemistry, P. S. Kalsi and J. P. Kalsi. New Age International, 2010
4. Inorganic Biochemistry vol. I and II ed. G.L. Eichhorn, Elsever.
5. Progress in Inorganic Chemistry, Vol 18 and 38 ed J.J. Lippard, Wiley.

CHY 111 – Practical A - INORGANIC CHEMISTRY

Ex. I Qualitative analysis of mixture consisting of eight radicals (cationic/anionic forms):

- a. Less common metal ions: Ti, Mo, W, Tl, Zr, Th, V, U
- b. Insolubles: Oxides, sulphates and halides.
- c. Interfering anionic radicals.

Ex. II Quantitative analysis: Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.

Ex. III Preparations

Preparation of selected inorganic compounds and their studies by I.R. spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds.

1. $[\text{VO}(\text{acac})_2]$
2. $[\text{Mn}(\text{acac})_3]$
3. Prussian Blue, Turnbull's Blue.
4. $[\text{Co}(\text{NH}_3)_6][\text{Co}(\text{NO}_2)_6]$

CHY 112 - Practical B - ORGANIC CHEMISTRY

Qualitative Analysis: Separation, purification and identification of compounds of binary mixture [(one liquid and one solid) or (two solids)] using TLC and column chromatography, chemical tests, IR spectra to be used for functional group identification.

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CHY 113 - Practical C- PHYSICAL CHEMISTRY

I. Error Analysis and Statistical Data Analysis:

Errors, types of errors minimization of errors, distribution curves, precision, accuracy, and combination, statistical treatment for error analysis, student 't' test, null hypothesis, rejection criteria, F& Q test; linear regression analysis, curve fitting calibration of volumetric apparatus burette, pipette and standard flask.

II. Adsorption

To study surface tension concentration relationship for solution (Gibbs equation)

III. Conductometry :

- i. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
- ii. Determination of solubility and solubility product of sparingly soluble salts (e.g. PbSO_4 , BaSO_4) conductometrically.
- iii. Determination of the strength of strong and weak acids in a given mixture conductometrically.
- iv. To study the effect of solvent on the conductance of AgNO_3 /acetic acid and to determine the degree of dissociation and equilibrium constant in different solvents and in their mixtures (DMSO, DMR dioxane, acetone, water) and to test the validity of Debye-Huckel-Onsager theory.
- v. Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's limiting law.

IV. Phase Equilibrium:

- i. Determination of congruent composition and temperature of a binary system (e.g., diphenylamine-benzophenone system)
- ii. Determination of Glass transition temperature of a given salt (e.g., CaCl_2) conductometrically.
- iii. To construct the phase diagram for three component system (e.g. chloroform-acetic acid water).

CHY 201: INORGANIC CHEMISTRY

UNIT-I

Symmetry and Group Theory in Chemistry

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Symmetry elements and symmetry operation, definition of group, subgroup, conjugacy relation and classes. Point symmetry group. Schoenflies symbols, representations of groups by matrices (representation for the C_{nh} , C_{nv} , etc, group to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy. Derivation of character table for C_{2v} and C_{3v} point group. Symmetry aspects of molecular vibrations of H_2O molecule.

UNIT-II

Molecular Rearrangement Processes

Electron transfer reactions (outer and inner sphere), HOMO and LUMO of oxidant and reductant, chemical activation. Precursor complex formation and rearrangement, nature of bridge ligands, fission of successor complexes, Two-electron transfers, Synthesis of coordination compounds using electron transfer reactions, mixed valence complexes and internal electron transfer.

UNIT-III

Electronic Spectra of Transition Metal Complexes

Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1 - d^9 states), calculations of Dq , B and β parameters, charge transfer spectra.

UNIT-IV

Optical Rotatory Dispersion (ORD) -Circular Dichroism (CD) and Magnetic Properties of Transition Metal Complexes

Spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical conformation, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

SUGGESTED BOOKS AND REFERENCES

1. Inorganic Chemistry, Principles of Structure and Reactivity, 4th Edition by James E. Huheey; Elleu A. Keiter; Richard L. Keiter.
2. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkinson.
3. Theoretical Inorganic Chemistry by Day and Selbin.
4. Concepts and Models in Inorganic Chemistry by Douglas Mc Daniel.
5. Introductory Quantum Chemistry by A.K. Chandra (Tata McGraw Hill)

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CHY 202: ORGANIC CHEMISTRY

UNIT - I

Stereochemistry

Optical activity and chirality, elements of symmetry, molecules with more than one chiral center. DL,RS and EZ nomenclature, enantiotopic and diastereotopic atoms, groups, and faces. Stereospecific and stereoselective synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus. Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity. Asymmetric synthesis. Cram's, Prelog's and Horeau's rules. Circular birefringence, CD, ORD, Octant rule, Cotton effect. The axial haloketone rule. Determination of configuration (absolute and relative) and conformation.

UNIT - II

Reagents and methods in Organic Synthesis

Principle, preparations, properties and applications of the following in organic synthesis with mechanistic details -

Phase transfer catalysts, Crown ethers and cryptands, Merrifield resin, DCC (Dicyclohexylcarbodiimide), Wilkinson's catalyst, Tributyltin hydride, Selenium dioxide, DDQ (2,3-Dichloro-5,6-dicyano-1,4-benzoquinone), 1,3-Dithiane, Thallium nitrate, Peterson reaction, Suzuki coupling, Negishi coupling, Heck reaction.

UNIT - III

Molecular Rearrangements

Mechanistic aspects, nature of the migration, migratory aptitudes, memory effects.

A detailed study of the following rearrangements -

The Dienone - Phenol rearrangement, The Benzil - benzilic acid rearrangement, The Favorskii rearrangement, The Neber rearrangement, The Beckmann rearrangement, The Hofmann rearrangement, The Curtius rearrangement, The Lossen rearrangement, The Wolff rearrangement, The Baeyer - Villiger rearrangement, The Wittig rearrangement, The Fritsch - Buttenberg - Wiechell rearrangement, The Stevens rearrangement, The Chapman rearrangement, The Wallach rearrangement.

UNIT - IV

Pericyclic Reactions

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Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward - Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions - conrotatory and disrotatory motions, $4n$, $4n+2$ and allyl systems. Cycloadditions - antarafacial and suprafacial additions. $4n$ and $4n+2$ systems, $2+2$ addition of ketenes, 1, 3-dipolar cycloadditions and cheletropic reactions.

Sigmatropic rearrangements - suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5-sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.

CHY 203: PHYSICAL CHEMISTRY

UNIT I

Classical Thermodynamics

Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity.

Non-ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength.

Application of phase rule to three component systems; second order phase transitions.

UNIT II

Statistical Thermodynamics

Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translation, rotational, vibrational and electronic partition functions. Calculation of thermodynamic properties in terms of partition functions. Application of partition functions.

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Heat capacity behavior of solids-chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac statistics, distribution law and applications to metal. Bose-Einstein statistics distribution Law and application to helium.

UNIT III

Chemical Kinetics - I

Methods of determining rate laws, collision theory of reaction rates. steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions.

Dynamic chain reactions (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine) reactions.

UNIT IV

Chemical Kinetics - II

Kinetics of polymerization, mechanism of polymerization. Kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reactions).

SUGGESTED BOOKS AND REFERENCES

1. Physical Chemistry, P.W. Atkins, ELBS
2. Chemical Kinetics, K.J. Laidler, McGraw-Hill.
3. Kinetics and Mechanism of Chemical Transformation, J. Rajaraman and J. Kuriacose, McMillan, publication
4. Thermodynamics, Kinetic theory and statistical Thermodynamics by T.M. Maridasan, Narosa 4 Physical, publication
5. Thermodynamics by Mishra & R.P. Rastogi S. Chand, publication

CHY 204 – SPECTROSCOPY-II

UNIT-I

Ultraviolet and Visible Spectroscopy

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Various electronic transitions (185-800 nm) Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls.

Infrared Spectroscopy

Instrumentation and sample handling

Characteristic vibrational frequencies of aromatic compounds, alcohols, ethers, phenols and amines Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance.

UNIT-II

Nuclear Magnetic Resonance Spectroscopy

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra). Stereochemistry, hindered rotation. Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra nuclear magnetic double resonance. NMR shift reagents, solvent effects Fourier transform technique, nuclear overhauser effect (NOE)

UNIT-III

Carbon-13 NMR Spectroscopy

General consideration, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.

NMR spectra of nuclei other than ^1H and ^{13}C : ^{19}F , ^{31}P & ^{11}B

UNIT-IV

Mass spectrometry

Introduction, ion production-EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds common functional groups, molecular ion peak, metastable peak. McLafferty rearrangement, Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

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SUGGESTED BOOKS AND REFERENCES

1. Physical Methods for Chemistry, R.S. Drago. Saunders Company.
2. Structural Methods in Inorganic Chemistry, E.A.V Ebsworth, D.W.H. Rankin and S. Cradock. ELBS.
3. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
4. Progress in inorganic Chemistry Vol., 8, ed., F.A. Cotton, Vol., 15, ed S.J. Lippard, Wiley.
5. Transition Metal Chemistry ed. R.I. Carlin Vol. 3 dekker.
6. Inorganic Electronic Spectroscopy, A.B.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry. R.V. Parish, Ellis Harwood.
8. Practical NMR Spectroscopy. M.L. Martin. J.J. Delpeuch and GJ. Martin. Heyden.
9. Spectrometric Identification of Organic Compounds, R.M. Silverstein. G.C. Hassler and T.C. Morrill, John Wiley.
10. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
11. Application of Spectroscopy of Organic Compounds, J.R Dyer, Prentice Hall.
12. Spectroscopic Methods in Organic Chemistry D.H. Williams, I, Fleming, Tata McGraw-Hill.

CHY 205: BIOORGANIC CHEMISTRY

UNIT-I

Enzymes

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling

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and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michael's-Menten and Lineweaver burk plots, reversible and irreversible inhibition.

UNIT-II

Mechanism of Enzyme Action

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase.

Kinds of Reactions Catalysed by Enzymes

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in Isomerisations reactions, β -Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

UNIT-III

Co-enzyme Chemistry

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD^+ , NADP^+ , FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors.

Enzyme Models

Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality biometric chemistry, crown ether, cryptates, cyclodextrins, cyclodextrin-based enzyme models, clixarenes, ionospheres, micelles synthetic enzymes or synzymes.

UNIT-IV

Biotechnological Applications of Enzymes

Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese-making, syrups from crown starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA Technology.

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SUGGESTED BOOKS AND REFERENCES

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice hall.
3. Enzyme Chemistry: Impact and Applications, Ed. Collin J Suckling, Chemistry.
4. Enzyme Mechanisms, Ed. M.I. Page and A Williams, Royal Society of Chemistry.
5. Bioorganic and Supramolecular Chemistry, P S Kalsi and J P Kalsi, New Age International Publication (2010).

CHY206: ENVIRONMENTAL CHEMISTRY

UNIT-I

Atmospheric Chemistry

Atmospheric layers, Vertical temperature profile, heat/radiation budget of the earth atmosphere systems. Properties of troposphere, thermodynamic derivation of lapse rate. Temperature inversion. Calculation of Global mean temperature of the atmosphere. Pressure variation in atmosphere and scale height. Biogeochemical cycles of carbon, nitrogen, sulphur, phosphorus oxygen. Residence times. Sources of trace atmospheric constituents : nitrogen oxides, sulphur dioxide and other sulphur compounds, carbon oxides, chlorofluorocarbons and other halogen compounds, methane and other hydrocarbons.

Tropospheric Photochemistry

Mechanism of photochemical decomposition of NO_2 and formation of ozone. Formation of oxygen atoms, hydroxyl, hydroperoxy and organic radicals and hydrogen peroxide. Reactions of hydroxyl radicals with methane and other organic compounds. Reactions of OH radicals with SO_2 and NO_2 . Formation of Nitrate radical and its reactions. Photochemical smog, meteorological conditions and chemistry of its formation.

UNIT-II

Air Pollution

Air pollutants and their classifications. Aerosols-sources, size distribution and effect on visibility, climate and health.

Acid Rain

Definition, Acid rain precursors and their aqueous and gas phase atmospheric oxidation reactions, damaging effects on aquatic life, plants, buildings and health. Monitoring of SO_2 and NO_x , acid rain control strategies.

Wheeler

Stratospheric Ozone Depletion

Mechanism of ozone formation, Mechanism of catalytic ozone depletion, discovery of Antarctic ozone hole and role of chemistry and meteorology, control Strategies.

Green House Effect

Terrestrial and solar radiation spectra, major green house gases and their sources and global warming potentials. Climate change and consequences.

Urban Air Pollution

Exhaust emissions, damaging effects of carbon monoxide, monitoring of CO, control strategies.

UNIT-III

Aquatic Chemistry and Water Pollution

Redox chemistry in natural waters. Dissolved oxygen, biological oxygen demand, chemical oxygen demand, determination of DO, BOD and COD. Aerobic and anaerobic reactions of organic sulphur and nitrogen compounds in water, acid-base chemistry of fresh water and sea water. Aluminum, nitrate and fluoride in water, petrification, sources of water pollution, treatment of waste and sewage, purification of drinking water, techniques of purification and disinfection.

UNIT-IV

Environmental Toxicology

Toxic Heavy Metals: Mercury, lead, arsenic and cadmium, causes of toxicity, bioaccumulation, sources of heavy metals, chemical speciation of Hg, Pb, As, and Cd, biochemical and damaging effects.

Toxic Organic Compound: Pesticides, classification, properties and uses of organochlorine and ionospheres pesticides, detection and damaging effects.

Polychlorinated Biphenyls: Properties, use and environmental continuation and effects.

Polynuclear Aromatic Hydrocarbons: Source, structures and as pollutants.

Soil and Environmental Disasters: Soil composition, micro and macronutrients, soil pollution by fertilizers, plastic and metals. Methods of re-mediation of soil. Bhopal gas tragedy, Chernobyl, three mile island, Minimtata disease, Sevoso (Italy), London smog.

SUGGESTED BOOKS AND REFRENCES

1. Environmental Chemistry, Colin Baird, W.H. Freeman Co. New York, 1998.
2. Chemistry of Atmospheres, R.P. Wayne, Oxford.
3. Environment Chemistry, A.K. De, Wiley Eastern, 2004.
4. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
5. Introduction to Atmospheric Chemistry, P.V. Hobbs, Cambridge.

Manahan

CHY 211 – Practical A - INORGANIC CHEMISTRY

Ex. I Preparation (Any Six) Preparation of selected inorganic compounds and their study by I. R., spectra, Mossbauer. ESR and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines. Selection can be made from the following:

1. Sodium amide. Inorg. Synth., 1946, 2, 128.
2. Synthesis and thermal analysis of group II metal oxalate hydrate. J. Chem. Ed., 1988, 65, 1024.
3. Atomic absorption analysis of Mg and Ca.
4. Trialkoxyboranes-IR and NMR spectra.
5. PhBd₂ Dichlorophenylborane - Synthesis in vacuum line.
6. Preparation of Tin (IV) iodide, Tin (IV) chloride and Tin (II) iodide, Inorg, Synth., 1953, 4, 119.
7. Relative stability of Tin (IV) and Pb (IV). Preparation of ammonium hexachlorostannate (NH₄)₂ SnCl₆ ammonium hexachloroplumbate (NH₄)₂PbCl₆.
8. Hexa-bis (4,nitrophenoxy) cyclotriphosphazene.
9. Synthesis of trichlorodiphenylantimony (V) hydrate. Inorg. Synth., 1985, 23, 194
10. Sodium tetrathionate Na₂S₄O₆.
11. Metal complexes of dimethyl sulfoxide (IR): CuCl₂.2DMSO, PdCl₂. 2DMSO, RuCl₂. 4DMSO. J.Chem. Educ., 1982, 59, 57.
12. Synthesis of metal acetylacetonate: Magnetic moment, IR, NMR, Inorg. Synth., 1957, 5, 130, 1963, 1, 183.
13. Bromination of Cr (acac)₃. J. Chem. Edu., 1986, 63, 90.
14. Magnetic moment of Cu (acac)₂H₂O.
15. Cis and Trans [Co(en)₂Cl₂]⁺.
16. Separation of optical isomer of cis-[Co(en)₂Cl₂]Cl; J. Chem. Soc., 1960. 4369.
17. Ion exchange separation of oxidation state of vanadium. J. Chem. Educ., 1980, 57, 316; 1978, 55, 55.
18. Determination of Cr (III) complexes; [Cr(H₂O)₆]NO₃.3H₂O, [Cr(H₂O)₄Cl₂]Cl.2H₂O, [Cr(en)₃]Cl₃, Cr(acac)₃; Inorg. Synth., 1972, 13, 184.
19. Preparation of N, N bis (salicylaldehyde) ethylenediamine, Salen H₂. Co(Salen) J. Chem. Educ., 1977, 54, 443; 1973, 50, 670.
20. Preparation of Fe(II) chloride (use it as Friedel-Craft Chlorination source) J. Org. Chem., 1978, 43, 2423; J. Chem. Edu., 1984, 61, 645; 1986, 63, 361.
21. Reaction of Cr (III) with a multidentate ligand; a kinetics experiment (visible spectra Cr-EDTA complex) J.A.C.S., 1953, 75, 6570.
22. Preparation and use of Ferrocene. J. Chem. Edu. 1966, 43, 73; 1976, 53, 730.
23. Preparation of copper glycine complex-cis and trans bis (glycinato Copper (II)). J. Chem. soc. Dalton, 1979, 1901, J. Chem. Edu., 1982, 59, 1052.
24. Preparation of phosphine Ph₃P and its transition metal complexes.
25. Any other experiment such as conversion of p-xylene to terephthalic acid catalyzed by CoBr₂ (homogeneous catalysis).
26. Preparation of [Co (phenanthroline-5,6 quinone)].

Ex. II Spectrophotometric Determinations (Any One)

- a. Manganese/Chromium/Vanadium in steel sample.

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- b. Nickel/molybdenum/tungston/vanadium/uranium by extractive spectrophotometric method.
- c. Fluoride/nitrite/phosphate.
- d. Zirconium-alizarin Red-S complex: Mole-ratio method.
- e. Copper-Ethylene diamine complex: Slope-ratio method.
- f. Iron-phenanthroline complex: Job's method of continuous variations.

CHY 212 - Practical B - ORGANIC CHEMISTRY

Organic Synthesis

1. Aniline \rightarrow 2,4,6 - Tribromoaniline 1,3,5 - \rightarrow Tribromobenzene
2. Aniline \rightarrow Diazoaminobenzene \rightarrow p-Aminoazobenzene
3. Nitrobenzene \rightarrow m-dinitrobenzene \rightarrow m- nitroaniline
4. Phthalic anhydride \rightarrow Fluorescein \rightarrow Eosin
5. Phthalic anhydride \rightarrow phthalimide \rightarrow Anthranilic acid
6. Acetanilide \rightarrow p-bromoacetanilide \rightarrow p-bromoaniline
7. Acetanilide \rightarrow p-nitroacetanilide \rightarrow p-nitroaniline

The products may be characterized by spectral techniques.

Quantitative Analysis

1. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
2. Estimation of amines/phenols using bromate-bromide solution or acetylation method.
3. Estimation of Sulphur by Messenger or Fusion method.
4. Determination of Iodine and Saponification values of an oil sample.

CHY 213 - Practical C- PHYSICAL CHEMISTRY

I. Chemical Kinetics

- i. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactant and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
- ii. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
- iii. Determination of the rate constant for the oxidation of iodide ions by peroxide studying the kinetics as an iodine clock reaction

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- iv. Flowing clock reaction (Ref: Experiments in physical Chemistry by Snowmaker).
- v. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion).
- vi. Oscillatory reaction.

II. Solutions:

- i. Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by cryscopic method and to determine the activity coefficient of an electrolyte.
- ii. Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.

III. Potentiometry / pH metry

- i. Determination of strengths of halides in a mixture potentiometrically
- ii. Determination of the valency of mercurous ions potentiometrically.
- iii. Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.
- iv. Determination of temperature dependence of EMF of a cell.
- v. Determination of the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.
- vi. Acid-base titration in a non-aqueous media using a pH meter.
- vii. Determination of activity and activity coefficient of electrolytes.
- viii. Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by monobasic/dibasic acid by albert-Serjeant method.
- ix. Determination of thermodynamic constants, ΔG , ΔS , and ΔH for the reaction by e.m.f. method. $Zn + H_2SO_4 \rightarrow ZnSO_4 + 2H$

IV. Polarimetry

- i. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.
- ii. Enzyme kinetics-inversion of sucrose.

CHY301- INORGANIC MATERIALS AND NANOTECHNOLOGY

UNIT-I

Solid State Chemistry

Introduction to the solid state, electrical, optical, magnetic and thermal properties of inorganic materials; Solid State Reactions: general principles, co-precipitation as a precursor to solid state reactions, kinetics of solid state reactions.

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UNIT-II

Superconductors

Superconductors, with special emphasis on the synthesis and structure of high temperature superconductors; solid state lasers (Ruby, YAG and tunable lasers); Inorganic phosphor materials; synthesis and advantages of optical fibers over conducting fibres, diffusion in solids, catalysis and zone refining of metals.

UNIT-III

Diffraction Methods

A. X-ray Diffraction

Bragg condition, Miller indices, Laue Method, Bragg method, Debye Scherrer 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, structure factor and its relation to intensity and electron density, phase problem; description of the procedure for an X-ray structure analysis, absolute configuration of molecules.

B. Electron Diffraction

Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, low energy electron diffraction and structure of surfaces.

UNIT-IV

Nanomaterials

Preparation of nanomaterials and their characteristic differences over bulk materials; dynamic light scattering, atomic force microscopy and characterization of nanomaterials; imaging techniques: electron microscopy (Scanning Electron Microscopy, Tanning Electron Microscopy)

SUGGESTED BOOKS AND REFERENCES

1. H. V. Keer, Principles of the Solid State; Wiley Eastern Ltd.: New Delhi (1993).
2. A. R. West, Solid State Chemistry and its Applications; John Wiley and Sons (1987).
3. N. B. Hannay, Treatise on Solid State Chemistry; Plenum (1976).
4. A. K. Cheetham and P. Day, Eds. Solid State Chemistry Techniques; Clarendon Press, Oxford (1987)
5. G. Timp, Ed. Nanotechnology; Springer-Verlag: N. Y. (1999).
6. Solid State Chemistry, D. K. Chakrabarty; New Wiley Eastern (2009).

CHY302- GREEN CHEMISTRY

Unit 1: Introduction, Principle and Concepts of Green Chemistry

What is green chemistry? Need for green chemistry: inception and evolution of green chemistry; twelve principles of green chemistry with their explanations and examples; designing a green synthesis using these principles; green chemistry in day to day life.

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Unit 2: Non traditional greener alternative approaches

Different approaches to green synthesis (a) uses of green reagents in green synthesis- Dimethyl carbonate; polymer supported reagents- per acids and chromic acid. (b) Green catalysts; oxidation catalysts; basic catalysts and polymer supported catalysts. (c) Phase transfer catalysts in green synthesis; advantages of PTC reactions to green synthesis; application of PTCs in N \C-alkylation; Darzens reaction; Wittig reaction; heterocyclic compounds- 3-alkyl coumarins; flavanones; oxidation using H₂O₂ under PTC conditions; use of crown ethers in esterifications; aromatic substitutions and eliminations reactions. (d) Biocatalysts in organic synthesis: introduction; microbial oxidation and reduction; production of fine chemicals.

Unit 3: Application of non conventional energy sources: Microwave induced and ultrasound assisted green synthesis.

Introduction of microwave induced organic and inorganic synthesis; microwave activation-equipment; time and energy benefits; limitations; (a) synthesis of nitrogen-oxygen/sulfur donor ligands and their coordination complexes; synthetic organic transformations under microwaves (b) Reactions in organic solvents- esterification: Fries rearrangement: Diels-Alder reaction and decarboxylation.

(c) Solvent free reactions (Solid state reactions): deacetylation; deprotection; saponification of ester; alkylation of reactive methylene compounds; synthesis of nitriles from aldehydes; heterocyclic synthesis- β -Lactams, pyrrole, quinoline.

Ultrasound assisted green synthesis: introduction; instrumentation; physical aspects; oxidation; reduction; addition, substitution reactions and synthesis of chromenes.

Unit 4: Environmentally Benign Solutions to Organic Solvents (focus on water and ionic liquids).

(a) Ionic liquids as green solvents- introduction; properties and types of ionic liquids; synthetic applications- Diels-Alder reaction; epoxidation; Heck reaction; preparation of pharmaceutical compounds; enzyme catalised synthesis.

(b) Aqueous phase reactions- introduction; Pseudo organic solvent

(i) Application in oxidation of nitro; aromatic and carbonyl compounds; reduction of carbon-carbon multiple bond, Benzoin condensation; Michael reaction; Claisen rearrangement; Knoevenagel reaction.

(ii) Electrochemical synthesis- introduction, synthesis of sebacic acid, adiponitrile.

Introduction on role of fluorus solvents and supercritical carbon dioxide in green chemistry.

SUGGESTED BOOKS AND REFERENCES

1. Organic Synthesis in water, Paul A. Grieco Blackie.
2. Green Chemistry, theory and practice, Paul T. Anastas and John C. Warner.

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3. New Trends in Green chemistry, V. K. Ahluwalia and M. Kidwai.
4. Organic Synthesis: Special techniques, V. K. Ahluwalia and Renu Aggarwal.
5. *Chem. Rev.* **2007**, 107, 2167-2820 (special issue on Green Chemistry).
6. Lancaster, M. *Green Chemistry: An Introductory Text*; The Royal Society of Chemistry: Cambridge, UK, 2002.

CHY303- BIOPHYSICAL CHEMISTRY

UNIT I

Bioenergetics

Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP. Muscular contraction and energy generation in mechanochemical system.

UNIT II

Bioenergetics of coupled reactions, free energy change, Relationship between ΔG and $[P]/[S]$ ($S \rightarrow P$). Addition of ΔG values for coupled reactions, metabolism and ATP yield.

UNIT III

Cell Membrane and Transport of Ions

Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport, Nerve conduction. Donnan membrane equilibrium. Active transport mechanisms. Autoanalyzers, its parts and functioning. Radio isotopes, units, specifications, dilution factor, Percentage incorporation, measurements.

UNIT IV

(A) Enzyme Assays

- (i) spectrophotometry
- (ii) fluorometry
- (iii) Polarimetry

(B) Determination of size, shape and molecular weight of proteins

- (i) Gel filtration
- (ii) SDS Gel filtration
- (iii) Sedimentation velocity

(C) Biological Half life: Effective half life, Stable isotopes, Radioactive tracer and dilution analysis.

SUGGESTED BOOKS AND REFERENCES

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1. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry, E.E. Conn and P. K. Stumpf, John Wiley.
6. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H Dugas and C. Penny, Springer - Verlag.
7. Macromolecules: Structure and Function, F. Wold, Prentice Hall.

CHY 311 - Practical A- INORGANIC CHEMISTRY

Ex. I Quantitative determinations of a three component mixture:

One volumetrically and two gravimetrically

- a. Cu^{+2} , Ni^{+2} , Zn^{+2}
- b. Cu^{+2} , Ni^{+2} , Ag^{+2}

Ex. II Chromatographic separations by paper chromatography and determination of Rf values

- a. Cadmium and Copper
- b. Zinc and Magnesium.

SUGGESTED BOOKS AND REFERENCES

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly. Prentice Hall.
3. Inorganic Experiments, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M. Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrand.

CHY 312 - Practical B - ORGANIC CHEMISTRY

Qualitative Analysis

Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid or two solids and one liquid), using TLC for checking the purity of separated compounds, chemical analysis, IR, PMR and Mass spectral data.

Multi-step Synthesis of Organic Compounds

The exercise should illustrate the use of organic reagents and may involve purification of products by chromatographic techniques. Photochemical reaction Benzophenone->

W. S. Marr

Benzpinacol->Benzpinacolone Beckman Rearrangement : Benzanilide from benzene
Benzene->Benzophenone-> Benzophenone oxime->Benzanilide Benzilic acid rearrangement:
Benzilic acid from benzoin Benzoin->Benzil->Benzilic acid Synthesis of heterocyclic
compounds Skraup synthesis: Preparation of quinoline from aniline Fisher Indole synthesis:
Preparation of 2-phenylindole from phenylhydrazine. Enzymatic synthesis, Enzymatic
reduction: reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of
S (+) ethyl-3-hydroxybutanoate and determine its optical purity. Biosynthesis of ethanol from
sucrose. Synthesis using microwave Alkylation of diethyl malonate with benzyl chloride.
Synthesis using phase transfer catalyst. Alkylation of diethyl malonate or ethyl acetoacetate
with an alkyl halide.

Paper Chromatography

Separation and identification of the sugars present in the given mixture of glucose, fructose
and sucrose by paper chromatography and determination of R_f values.

Spectroscopy

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR,
CMR and MS)

CHY 313 - Practical C- PHYSICAL CHEMISTRY

(A) Thermodynamics

- i. Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
- ii. Determination of the temperature dependence of the solubility of a compound in two solvents having similar intramolecular interactions (benzoic acid in water and in DMSO-water mixture) and calculate the partial molar heat of solution.

(B) Spectroscopy

- i. Determination of pK_a of an indicator (e.g. methyl red) in (a) aqueous and (b) micellar media.
- ii. Determination of stoichiometry and stability constant of Ferricisothiocyanation complex ion in solution.
- iii. Determination of rate constant of alkaline bleaching of Malachite green and effect of ionic strength on the rate of reaction.

(c) Polarography

- i. Identification and estimation of metal ions such as Cd²⁺, Pb²⁺, Zn²⁺, and Ni²⁺ etc. polarographically.

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- ii. Study of a metal ligand complex polarographically (using Lingane's Method).

(C) Chemical Kinetics

- i. Determination of rate constant and formation constant of intermediate complex in the reaction of Ce (IV) and Hypophosphorous acid at ambient temperature.
- ii. Determination of energy and enthalpy of activation in the reaction of KMnO_4 and benzyl alcohol in acid medium.
- iii. Determination of energy of activation and entropy of activation from a single kinetic run.
- iv. Kinetics of an enzyme catalyzed reaction.

CHY 424- SEMINAR

MTM 425 – PROJECT WORK

CHY A01: PHOTOINORGANIC CHEMISTRY

UNIT-I

Properties of Excited States

Structure, dipole moment, acid-base strengths, reactivity. Photochemical kinetics-calculation of rates of radiative processes. Bimolecular deactivation-quenching.

UNIT-II

Excited States of Metal Complexes

Excited states of metal complexes: Comparison with organic compounds, electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations.

UNIT-III

Ligand Field Photochemistry

Photosubstitution, photooxidation and photoreduction, lability and selectivity, zero vibrational levels of ground state and excited state, energy content of excited state, zero-zero spectroscopic energy, development of the equations for redox potentials of the excited states.

UNIT-IV

Redox Reactions by Excited Metal Complexes

Redox reactions of metal complexes in excited states, excited electron transfer, examples using $[\text{Ru}(\text{bpy})_3]^{2+}$ complex and $[\text{Fe}(\text{bpy})_3]^{3+}$ complex. Role of spin-orbit coupling, life-times of excited states in these complexes.

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Metal Complex Sensitizers: Electron relay, semiconductor supported metal oxide systems, water-photolysis, nitrogen fixation and carbon dioxide reduction.

SUGGESTED BOOKS AND REFERENCES

1. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
2. Inorganic Photochemistry, J.Chem. Educ. vol. 60 No. 10, 1983.
3. Progress in Inorganic Chemistry, Vol. 30ed. S.J. Lippard. Wiley.
4. Coordination Chem. Revs. 1981, vol. 39, 121, 1231, 1975, 14, 321,; 1990 97, 313.
5. Photochemistry of Coordination Compounds, V. Balzari and V. Carassiti, Academic Press.
6. Elements in Inorganic Photochemistry, G.J. Ferraudi, Wiley.

CHY A02: ORGANOTRANSITION METAL CHEMISTRY

UNIT-I

Preparation, Properties, Structure and Bonding of:

(Giving some specific examples)

- (i) η^1 - bonded alkyl complexes
- (ii) η^1 - carbene and carbyne complexes
- (iii) η^2 - alkene and alkyne complexes
- (iv) η^3 - allyl complexes
- (v) η^4 - dienyl complexes
- (vi) η^5 - dienyl complexes
- (vii) η^6 - arene and triene complexes
- (viii) η^7 -cyclo hepta trienyl complexes
- (ix) η^8 - cyclooctatetraene complexes

UNIT-II

Metal nitrosyls, cyanides and isocyanides

Synthesis reactions structure and bonding in metal nitrosyls:nitrosyl complexes, metal cyanides and isocyanides:cyanogens, cyanogen halides, cyanates and its analogue sulfur, selenium and tellurium ion. Diisocyanides, reaction of isocyanide complexes and their uses.

UNIT-III

Synthetic and Catalytic Aspects of Organotransition Metal Chemistry:

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- (i) Transition metal organometallics in organic synthesis
- (ii) Homogenous catalysis by transition metal organometallics
- (a) Hydrogenation of alkenes
- (b) Hydrosilylation of alkenes
- (c) metathesis of alkenes
- (d) Oligomerization and polymersization of alkenes and alkynes
- (e) Hydroformylation of alkenes
- (f) Acetic acid synthesis and other carbonylation reactions
- (g) Oxidation reactions of alkenes

UNIT-IV

Catalysis

- (a) Hetrogenous Catalysis by Organotransition Metal Compounds
- (b) Fisher tropsch synthesis: Methanation reactions, Synthesis of methanol, gasoline production, function of ZSM-5 Zeolite in stabilization of carbene molecule, application of reaction to industry.
- (c) Water gas shift reaction : Role of ZnO/Cr₂O₃ in the reaction, Acetic acid synthesis from water gas shift, Role of CO catalyst.
- (d) Fluxional organometallic compounds. Rate of rearrangement, Simple examples of non rigid molecules in different coordination geometries, classification, future developments.

SUGGESTED BOOKS AND REFERENCES

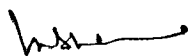
1. Principles and Applications of Organotransition Metal Chemistry, J.P. Collman, L.S. Heegsdu, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of Transition Metals, R.H. Crabtree, John Willey.
3. Metalloorganic Chemistry, A.J. Pearson, Wiley.
4. Organometallic Chemistry, R. C. Mehrotra and A. Singh, New Age International.
5. Reaction of Transition Metal Complexes, J.P. Candlin K. Aayler and D.T Thomson American Elsevier
6. Organometallic Compounds, Vol. II M. L. H. Green, Methuen.

CHY A03: SUPRA MOLECULAR CHEMISTRY

UNIT-I

Introduction

Definition and development of supramolecular chemistry, classification of supramolecular host-guest compounds. Nature of supramolecular interactions: ion-ion interactions, ion-dipole interactions, dipole-dipole interactions. Cation binding hosts, binding of anions, binding of neutral molecules, binding of organic molecules.



UNIT-II

Molecular Recognition

Receptors, design and synthesis of co receptors and multiple recognition. Hydrogen bonds, strong, weak and very weak H-bonds, utilization of H-bonds to create supramolecular structures, use of H-bonds in crystal engineering and molecular recognition.

UNIT-III

Supramolecular Reactivity and Catalysis

Supramolecular metallocatalysis, biomolecular and abiotic catalysis. Transport processes and carrier design, cation carriers, anion carriers, couples transport processes.

UNIT-IV

Devices and Chemistry

Supramolecular devices, supramolecular photochemistry, molecular and supramolecular photonic devices, photosensitive molecular receptors. Supramolecular chemistry of Fullerene, Fullerene as guests, Fullerene as hosts, Fullerene as superconducting intercalation compounds.

SUGGESTED BOOKS AND REFERENCES

1. Supramolecular Chemistry, J.M. Lehn, VCH
2. Supramolecular Chemistry, J.W. Steed and J.L. Atwood, WILEY
3. Bio-organic, Bio-inorganic and Supramolecular Chemistry, P.S.Kalsi and J.P.Kalsi, New Age International, 2010.

CHY A04: INORGANIC POLYMERS

UNIT-I

A general survey and scope of inorganic polymers special characteristics, classification, homo and hetero atomic polymers. Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights.

UNIT-II

Structure, Properties and Applications of

- a. Polymers based on Boron - Borazines, Boranes and Carboranes.
- b. Polymers based on Silicon - Silicones, Polymetalloxanes and Polymetallosiloxanes, Silazanes.

UNIT-III



Structure, Properties and Application of

- a. Polymers based on Phosphorous - Phosphazenes, Polyphosphates.
- b. Polymers based on Sulphur - Tetrasulphur tetranitride and related compounds.

UNIT-IV

Silicates and Aluminosilicates

- a. Classification, structure, properties and application of naturally occurring silicates and aluminosilicates.
- b. Synthesis and application of pillared clays and zeolites with emphasis of catalysis.

SUGGESTED BOOKS AND REFERENCES

1. Inorganic Chemistry, J.E. Huheey, Harper Row.
2. Developments in Inorganic Polymer Chemistry, M.F. Lappert and G.J. Leigh.
3. Inorganic Polymers- N.H. Ray.
4. Inorganic Polymers, Graham and Stone.
5. Inorganic Rings and Cages: D.A. Armitage.
6. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
7. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.
8. Structural Inorganic Chemistry, A. F. Wells, Oxford University Press.
9. Zeolites Molecular Sieves-Structure, Chemistry and Use, D.W. Breck, John Wiley & Sons.
10. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.

CHY A05: ADVANCED BIOINORGANIC CHEMISTRY

UNIT-I

Metalloenzymes:

Structure and functions of the following enzymes: carbonic anhydrase, carboxypeptidase, alcohol dehydrogenase, catalase and peroxidase, cytochrome P-450, super oxide dismutase and xanthin oxidase, coenzyme, vitamin B₁₂.

UNIT-II

Metal Storage and Transport:

Iron storage and transport – transferrin, ferritin and siderophores, other storage and transport systems – ceruloplasmin and serum albumin for copper, metallothioneins and phytochelatins – vanadium storage and transport.

UNIT-III

DNA and RNA

Metal complexes of polynucleotides, nucleosides and nucleic acids (DNA and RNA), Template temperature, stability of DNA.

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UNIT-IV

Metal Deficiency and Diseases:

Iron, zinc and copper deficiency – metal ion toxicity – copper over load and Wilson's disease – iron toxicity – toxicity of arsenic, cadmium, mercury and lead, metal complexes in medicine – chelation therapy – BAL, penicillamine, polyamino carboxylic acids and desferrioxamine – gold compounds and rheumatoid arthritis – platinum complexes as anticancer, drugs – metal complexes in radio diagnosis and magnetic resonance imaging.

SUGGESTED BOOKS AND REFERENCES

1. Principles of Bioinorganic Chemistry, S. J Lippard,. & J. M. Berg, University Science Books.
2. Progress in Inorganic Chemistry, S. J. Lippard,. Vols. 18 and 38, Wiley-Interscience.
3. Bioinorganic Chemistry, I Bertini, H.B. Gray. S.J. Lippard and J. S. Valentine, University Science Books.
4. Inorganic Biochemistry Vols I and II Ed. G.L. Eichhorn Elsevier.

CHY A06: MINERAL BASED INDUSTRIAL CHEMISTRY

UNIT – I

Industrial Chemistry

Ferrous and non-ferrous industries-quality, control methods, general principles applied in studying an industry-manufacture of iron, steel and special steels metallurgy of gold and silver.

UNIT –II

Cement

Classification of cement, manufacture of portland cement-setting and hardening of cement, chemical constitution of portland cement and their characteristics - special cements and their uses.

UNIT III

Ceramics

Classification of ceramics, basic raw material- application of colours to pottery porcelain and china ware- manufacture, glass-raw materials, manufacture of special glass-optical, borosilicate, flint and coloured glasses.

UNIT IV

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Poisons

Industrial poisons and their classification solid liquid and gaseous poisons-their identification- physiological activity and control; solids: Pb, As, Hg, asbestos, textile fibres; liquids: organic solvents, gases oxides of S, N and H₂S, cyanides, aldehydes, ketones and hydrocarbons.

SUGGESTED BOOKS AND REFERENCES

1. Chemical Process Industries; N.D. Shreeve.
2. Applied Chemistry for Engineer; Diamont.
3. Industrial Poisons and Solvents; Jacobs.
4. Chemistry of Engineering Materials; Jain & Jain.
5. Engineering chemistry; B. K.Sharma.
6. Environmental Chemistry; B.K.Sharma.
7. Corrosion. Volume I. Metal Environment Reactions, L. L. Shreir, Newnes Butterworths, London.
8. Corrosion Engineering; Fontana and Greene, McGraw Hill Publication.

CHY B01: NATURAL PRODUCTS - I

UNIT - I

Terpenoids and Carotenoids

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule., stereochemistry and synthesis of the following representative molecules: Citral, Geraniol α -Terpineol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β -Carotene.

UNIT-II

Alkaloids

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of

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alkaloids in plants. Structure, stereochemistry and synthesis of the following: Ephedrine, (+) - Coniine, Nicotine, Atropine, Quinine and Morphine.

UNIT-III

Steroids

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone and Progesterone.

UNIT-IV

Natural Pigments

Occurrence, nomenclature and general methods of structure determination. Isolation, structure determination and synthesis of Luteolin, Quercetin, Myrcetin, Quercetin 3-glucoside, Diadzein, Butin, Butein, Cyanidin chloride, Cyanidin-7-arabioside and Alizarin.

SUGGESTED BOOKS AND REFERENCES

1. Natural Products . Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Esses.
2. Organic Chemistry : Vol. 2, I. L. Finar, ELBS
3. Stereoselective Synthesis : A Practical Approach, M. Norgradi, VCH.
4. Chemistry of Natural Products : S. V. Bhat, B. A. Nagasampagi and M. Sivakumar, Narosa Publishing House.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. Harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm. Harwood Academic Publishers.
7. New Trends in Natural Product chemistry, Ata-ur-Rahman and M.L. Choudhary, Harwood Academic Publishers.

CHY B02: ORGANIC SYNTHESIS - I

UNIT I

Enolate Chemistry: Formation of enolates, kinetic and thermodynamic control. Reactions of enolate anions with electrophiles: O vs C alkylation. Enolate condensation reactions: inter- and intramolecular Aldol condensations, Claisen, Dieckmann, Knoevenagel, Stobbe condensations, Mukaiyama Aldol reaction. Boron enolates. Nozaki-Hiyama-Kishi coupling. Stereoselective enolate reactions: diastereoselection, Zimmermann-Traxler model, Evans model, Noyori open-chain model. Michael addition and related reactions- Michael addition, Baylis-Hillmann reaction, Robinson annulations. α -Halogenation, Reformatski reaction, Favorski rearrangement. McMurry coupling reaction.

UNIT II

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Metal and non-metal mediated oxidation: Mechanism, selectivity, stereochemistry and applications of Oppenauer oxidations, aromatization, dehydrogenation, cleavage of C=C bond, ozonolysis, epoxidations using peracids, Baeyer-Villiger oxidation. Oxidations using DDQ, NBS, lead tetraacetate, selenium dioxide, Ag, Cr and Mn reagents, periodic acid and osmium tetroxide. DMSO-based oxidations. Oxidation of S, Se and N compounds.

Hydroboration: Introduction, preparation of alkyl- and alkenyl boranes. Synthetic transformations: protonolysis, hydrohalogenation, coupling, isomerisation and displacement reactions. Asymmetric hydroboration. Preparation of amines and sulfides *via* hydroboration.

UNIT III

Metal and non-metal mediated reduction: Mechanism, selectivity, stereochemistry and applications of catalytic hydrogenations (using Pd, Pt and Ni catalysts), Clemmensen reduction, Wolff-Kishner reduction, Meerwin-Ponndorf-Verley, dissolving metal reductions, metal hydride reductions (NaBH_4 , LiAlH_4 , DIBAL); stereoselectivity in hydride reductions, Wilkinson Rh catalysis. Boron in reduction. Hydrosilylation. Photoreduction.

UNIT IV

Supramolecular Chemistry: Concepts: Definition and development, classification, receptors, clathrate and macrocyclic effects, thermodynamic and kinetic selectivity, nature of supramolecular interactions, supramolecular host design.

Supramolecular chemistry of life: Porphyrins and Tetrapyrrole macrocycles, uptake and transport of oxygen by hemoglobin.

Cation-binding hosts: Crown ethers, cryptands and spherands - Synthesis and properties.

Binding of anions: Biological anion receptors and organometallic receptors.

Templates and self-assembly: Introduction, catenanes and rotaxanes, helicates; synthetic considerations and properties.

Liquid crystals: Nature and structure, design of liquid crystalline materials, liquid crystalline polymers.

SUGGESTED BOOKS AND REFERENCES

1. Advanced organic chemistry, Part B, Carey A and Sundberg R.J., Plenum Press.
2. Advanced organic chemistry: Reactions, mechanism and stereochemistry, March J., John Wiley.
3. Theoretical organic chemistry, Parkanyi C., Elsevier
4. Strategic applications of named reactions in organic synthesis, Kurti L. and Czako B., Academic Press, 2005.
5. Organic synthesis, Smith M.B., McGraw Hill, 2002.
6. Organic synthesis: The disconnection approach, Warren S., John Wiley & Sons.
7. Design of organic synthesis, Warren S., Wiley



8. Classics in total synthesis, Nicolaou E.J., Chemie Verlag, 1996
9. The logic of chemical synthesis, Corey E.J. and Cheng X.M., John Wiley & Sons, 1989.
10. Reagents in Organic chemistry, Fieser and Fieser
11. Handbook of reagents in organic synthesis, P Wipf, John Wiley & Sons.
12. Protecting group in Organic synthesis, Greene T, Wuts P.G.M., John Wiley & Sons, 1989.
13. Modern methods of Organic synthesis, Carruther W., Cambridge University Press.
14. Organic synthesis: The science behind art, Smith W.A., Bochkor A.F., Caple, R., RSC, 1998
15. Supramolecular Chemistry – An Introduction, Vögtle F and Alfter F, J. Wiley & Sons: Chichester, 1993
16. Supramolecular Chemistry – Concepts and Perspectives, J-M Lehn, Wiley-VCH, 1995.

CHY B03: HETEROCYCLIC CHEMISTRY - I

UNIT – I

Nomenclature of Heterocycles

Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic fused and bridged Heterocycles.

Aromatic Heterocycles

General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ¹H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity.

UNIT – II

Non-aromatic Heterocycles

Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction. Stereo-electronic effects anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions.

UNIT – III

Small Ring Heterocycles- Three-membered and Four-membered Heterocycles:

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synthesis and reactions of aziridines, oxiranes, thiiranes, oxaziridines, azetidines, oxetanes, thietanes and azetidinones.

UNIT - IV

Five membered Heterocycles with Two Heteroatoms

Synthesis and reactions of 1,2- & 1,3- diazoles, oxazoles and thiazoles

Benzo-fused five-membered Heterocycles

Synthesis and reactions including medicinal applications of benzopyrroles, bezofurans, benzothiophenes and benzimidazoles.

CHYB04: NATURAL PRODUCTS

UNIT - I

Prophyrins

Structure, reactions and synthesis of Haemoglobin and Chlorophyll.

Prostaglandins

Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE₂ and PGF_{2α}.

UNIT - II

Pyrethroids

Introduction, structure elucidation and synthesis of pyrethroids, namely pyrethrins and cinerins. Structure-activity relationships and synthesis of various synthetic pyrethroids.

Rotenoids

Introduction, isolation, stereochemistry and classification. Synthesis of Rotenone.

Plant Hormones

Introduction, occurrence, isolation and physiological effects of Auxins, Gibberellins (Synthesis of GA₃), Cytokinins and Abscisic acid.

UNIT - III

Vitamins

Introduction, synthesis, biological functions and deficiency syndromes of Vitamin B (Thiamine), C, E and K.

Insect Hormones

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Introduction to BH, JH and MH, chemistry of JH, structure elucidation and synthesis, structural analogs. JH mimics – some structures, chemistry of Juvabione.

UNIT – IV

Biosynthesis

Biosynthetic pathways for terpenoids, alkaloids, steroids, pigments and hormones with emphasis to the compounds in the course.

SUGGESTED BOOKS AND REFERENCES

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthorpe and J.B. Harborne, Longman, Essex.
2. Organic Chemistry : Vol. 2 I L. Finar, ELBS
3. Stereoselective Synthesis : A Practical Approach, M. Norgradi, VCH.
4. Chemistry of Natural Products : S. V. Bhat, B. A. Nagasampagi and M. Sivakumar, Narosa Publishing House.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. Harwood Academic Publishers.

CHY B05: ORGANIC SYNTHESIS - II

UNIT I

Disconnection Approach: An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction.

Protecting groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups. Simple practice exercises.

UNIT II

One Group and Two Group C-C disconnections: One group C-C disconnections involving alcohols and carbonyl compounds, regioselectivity, Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.

Diels-Alder reaction, 1,3-difunctionalised compounds, α,β -unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annelation.

UNIT III

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Computer-aided Synthesis Planning: General concepts, Heindrickson's SYNGEN approach, Barone's MARSEIL/SOS and LHASA systems.

Stereogenic centres and planning of synthesis: Stereogenic skeletal bond forming reactions, asymmetric synthesis, synthesis of a racemate and resolution, incorporation of chiral building blocks.

UNIT IV

Ring Synthesis: Introduction to ring synthesis of saturated heterocycles. General strategy and stereoselectivity. 3-membered rings: cyclisations and insertion reactions. Rerarrangements in synthesis. 4-membered rings: photocycloadditions and use of ketenes. 5-membered rings: from 1,4- and 1,6-dicarbonyl compounds. Pericyclic rearrangements and special methods. 6-membered rings: carbonyl condensations, Diels-Alder reactions and reduction of aromatic compounds.

SUGGESTED BOOKS AND REFERENCES

1. Organic synthesis, Smith M.B., McGraw Hill, 2002.
2. Organic synthesis: The disconnection approach. Warren S. John Wiley & Sons. 2004
3. Designing organic synthesis – The synthon approach, Warren S., Wiley, 1978 (Re-printed 2002).
4. Organic Synthesis – Concepts, Methods and Starting Materials, J. Fuhrhop and G. Li, Wiley-VCH, 2003.
5. Modern methods of Organic synthesis, Carruther W., Cambridge University Press, 2004.
6. Modern Synthetic Reactions, H.O. House, W. A. Benjamin, 1972.

CHY B06: HETEROCYCLIC CHEMISTRY- II

UNIT-I

Five membered Heterocycles with more than two Heteroatoms

Syntheses and reactions of triazoles, tetrazoles, oxadiazoles and thiadiazoles

Meso-ionic Heterocycles

General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications.

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UNIT-II

Six-Membered Heterocycles with one Heteroatom

Synthesis and reactions of pyrylium salts, pyrones coumarins and chromones.

Six membered Heterocycles with two or more Heteroatoms: Synthesis and reactions of diazines, triazines, and tetrazines.

UNIT-III

Thiazines- 1,4-Benzothiazines and Phenothiazines.

Diazepines- 1,4 or 1,5-Benzodiazepines.

Thiazepines- 1,4 or 1,5-benzothiazepines.

UNIT-VI

Heterocyclic Systems Containing P and B

Heterocyclic rings containing Phosphorus: Introduction. nomenclature. synthesis and characteristics of 5- and 6-membered ring systems phospholes and phosphonines (with or without nitrogen atom). **Heterocyclic rings containing boron:** Introduction, synthesis reactivity and spectral characteristics of 5- and 6- membered ring systems- borole, borobenzene and borazine.

SUGGESTED BOOKS AND REFERENCES

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
5. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Paudler, Wiley-Inter Science.

Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds. Pergamon Press.

CHY C01: ELECTROANALYTICAL TECHNIQUES

UNIT - I

A.Errors Precision and Accuracy

Definition of terms in mean and median, Precision-Standard deviation, relative standard deviation, accuracy-absolute error, relative error. Types of error in experimental data determinate (systematic), indeterminate (or random) and gross. Sources of error and the effects upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data-indeterminate errors. The uses of statistics.

B.Chromatography and Applications

Thin layer chromatography (TLC), Adsorption (column) chromatography, High-performance liquid chromatography (HPLC) and Gas chromatography.

UNIT – II

A.Conductometry:

Important laws, definitions, relations, effect of dilution on conductivity, measurement of conductivity , types of conductometric titrations, its applications and limitations.

B.Potentiometry :

Principle, instrumentation, types of potentiometric titrations and its applications, pH measurements, determination of pH, ion selective electrodes, instrumentation and applications.

UNIT – III

Coulometry:

Introductions, principle, experimental details of coulometry at constant current and constant potential, titrational applications.

UNIT – IV

Atomic Absorption Spectroscopy

Introduction, principle, grotrian diagram, instrumentation, application, detection limit, sensivity and disadvangates.

SUGGESTED BOOKS AND REFRENCES

1. Principles of instrumental analysis D.A. Skoog and J.L. Loary. W.B. Saunders, CBS
2. Principles of Instrumental Analysis D.A. Skoog W.B. Saunders, CBS
3. Handbook of Instrumental Techniques for Analytical Chemistry F. Settle, Prentice Hall.

CHY C02: ELECTROCHEMISTRY - I

UNIT – I

Electro-chemical Energy Storage:

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Properties of Electrochemical energy storers: measure of battery performance, Charging and discharging of batteries, 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. Future electricity storers : Storage in (i) Hydrogen (ii) alkali metals, (iii) Non-aqueous solutions

UNIT – II

Bioelectrochemistry:

Membrane potential, simplistic and modern theory, Electrical conductance in biological organisms, electrochemical mechanism of nervous systems, enzymes as electrodes, Biosensors, Bioelectrocatalysis.

UNIT – III

Corrosion and Passivity:

Electrochemical mechanism of corrosion of metals, thermodynamics and stability of metals, potential - pH (or Pourbaix) Diagrams, uses and abuses, corrosion current and corrosion potential - Evans diagrams.

Measurement of corrosion rate: weight loss method & Electrochemical method.

Inhibition of Corrosion (i) by addition of substrates to the electrolyte environment (ii) By charging corroding method from external source, anodic protection, organic inhibitors. The fuller story, Green inhibitors.

Passivation : Structure of passivation films, mechanism of passivation, spontaneous passivation, nature's method for stabilizing surfaces.

UNIT – IV

Kinetics of Electrode Process:

Essentials of electrode reaction, current density, overpotential, Tafel equation, Butler Volmer equation. Standard rate constant (K^0) and Transfer coefficient (α), exchange current density. criteria of irreversibility information from irreversible wave.

Koutecky's method, Meits Israel and Gelling's method for determining kinetic parameters for quasireversible and irreversible waves.

SUGGESTED BOOKS AND REFERENCES

hsh

1. Modern, Electrochemistry, Vol. I, II A, Vol. II B, J' OM Bockris and A.K. N. Reddy, Plenum Publication, New York.
2. Polarographic Techniques by L. Meites, Intersciences. New York
3. Modern Polarographic Methods by A. M. Bond, Marcell Dekker.
4. Polarography and allied techniques by K. Zutshi, New Age International Publication, New Delhi

CHY C03: CHEMICAL KINETICS

UNIT - I

(a)**Oscillatory Reactions:** Autocatalysis and oscillatory reactions, Oscillatory reactions from the new point of thermodynamics. Kinetics and mechanism of Belousov-Zhabotinski (B-Z) reaction.

(b)**Enzymes and Inhibitors:** Enzyme catalyzed models of 1:2 type enzyme-substrate systems.

Kinetics of one enzyme-Two substrate systems and their experimental characteristics. Enzyme inhibitors and their experimental characteristics. Kinetics of enzyme inhibited reactions.

UNIT - II

Dynamics of Gas-Surface Reactions :

Adsorption/desorption kinetics and transition state theory, Dissociative adsorption and precursor state. Mechanism of Langimur's adsorption of the oxidation of carbon monoxide to carbon dioxide. True and apparent activation energies. Industrial importance of heterogeneous catalysis.

UNIT - III

Transition State:

A brief aspect of statistical mechanics and transition state theory, application in calculation of the second order rate constant for reactions with collision for (i) atom + atom (2) atom + molecule (3) molecule (for both linear and non-linear molecules) + molecule reactions. Static solvent effects and thermodynamic formulations. Adiabatic electron transfer reactions, energy surfaces.

UNIT - IV

Metal-ion Catalysis: Kinetics and Mechanism of following Reactions

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- (i) When reaction rate is independent of one of the reactants in presence of metal ion catalyst
- (ii) When reaction rate is retarded by one of the products in presence of metal ion catalyst.
- (iii) When metal ion catalysis indicates an intermediate species.
- (iv) Cyclodextrines are acting as catalyst mode of catalysis. Analysis of one full case study of B-cyclodextrine, catalysed reaction, Hydroformylation reaction.

SUGGESTED BOOKS AND REFERENCES

1. Progress in Inorganic chemistry, Vol. 30, 1967.
2. R. Lumry and R.W. Raymond, Electron transfer Reactions, Interscience.
3. N.L. Bender, Mechanism of Homogeneous catalysis from protein to protein, Wiley.
4. A.G. Sykes, Kinetics of Inorganic reactions, Pergamon.
5. S.W. Benson, Mechanism of Inorganic Reactions, Academic Press.
6. Physical chemistry Vol. 2, Ed. Prof. Ya Grasimov, Mir Publisher.
7. Basolo and Pearson, Inorganic Reaction Mechanism, Wiley
8. H. Taube, Electron transfer Reactions, Oxford Press.

CHY C04: CHEMICAL ANALYSIS

UNIT I

Water Analysis

Sources of water pollution domestic, industrial, agricultural soil and radioactive wastes as sources of pollution. Objectives of analysis-parameter for analysis color, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen. Heavy metal pollution-public health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic. General survey of instrumental technique for the analysis of heavy metals in aqueous systems. (Measurement

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of DO, BOD and COD) Pesticides as water pollutants and analysis. Water pollution laws and standards.

UNIT II

Food Analysis

Moisture, ash, crude protein, fat, crude fiber, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration-common adulterants in food, contamination of food stuffs. Microscopic examination of foods for adulterants. Pesticide analysis in food products. Extraction and purification of sample: HPLC, Gas chromatography for organophosphates. Thin-layer chromatography for identification of chlorinated pesticides in food products.

UNIT III

Soil and Fuel Analysis :

(a) Analysis of soil, moisture pH, total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts.

(b) Fuel analysis : liquid and gas. Ultimate and proximate analysis heating values-grading of coal. Liquid fuels flash point, aniline point, octane number and carbon residue. Gaseous fuels-producer gas and water gas-calorific value.

UNIT IV

Body Fluids and Drug Analysis :

Composition of blood collection and preservation of samples. Serum electrolytes, blood glucose, blood urea nitrogen, uric acid albumin, globulins acid and alkaline phosphatases, Immunoassay : Principle of radio immunoassay (RIA) and applications. The blood gas analysis trace elements in the body.

Narcotics and dangerous drugs classification of drugs. Screening by gas and thin layer chromatography and spectrophotometric measurements.

SUGGESTED BOOKS AND REFERENCES

1. Analytical Chemistry, G.D. Christian, J. Wicy
2. Fundamentals of analytical Chemistry, D.A. Skoog, D.M. West and F.J. Hooler, W.B. Saunders.
3. Analytical Chemistry – Principles, J.H. Kennedy, W.B. Saunders.

W.B. Saunders

4. Analytical Chemistry - Principles and Techniques. L.G. Hargis, Prentice Hall.
5. Quantitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
6. Environmental Solution, S.M. Khopkar, Wiley Eastern.
7. Basic Concepts of analysis Chemistry, S.M. Khopkar, Wiley Eastern.

CHY C05: ELECTROCHEMISTRY - II

UNIT I

Fuel Cells:

Electrochemical Generators (Fuel Cells) : Hydrogen oxygen cells. Hydrogen Air Cell, Hydrocarbon air cell, alkaline fuel cell, Phosphoric acid fuel cell, direct NaOH fuel cells, applications of fuel cells.

UNIT II

Electrocatalysis :

Chemical catalysis and Electrocatalysis, cathodic and anodic electro catalysis; electrocatalysis of mixed oxides of titanium doped with rare earth oxides (Ebonex); Electrolysis in simple redox reactions; Electrocatalysis of carbon nanotubes and bimetallic (alloys) Nano- structured materials.

UNIT III

Voltammetry :

General Principle and applications, linear sweep voltammetry (LSV), cyclic voltammetry (CV), square wave voltammetry, stripping voltammetry, cathodic adsorptive stripping voltammetry (CAAdSV), anodic adsorptive stripping voltammetry (AAAdSV) applications of stripping analysis.

UNIT IV

Electro-organic Synthesis:

Types of electro organic reactions, constant current and constant potential electrolysis, cell design, effect of variable, nature of medium, nature of electrode materials, over-voltage, effect of redox couple, application to sewage waste water treatment, electro-chemical incineration of human waste in combined space. Electro-organic synthesis of novel drugs.

SUGGESTED BOOKS AND REFERENCES

hkh

1. Electrochemical methods by Allen J. Bard and Larry R. Faulkner, John Wiley. Publication.
2. Electrochemistry by Carl H. Hamann, Andrew Hammett and Wolfgang Vielstich.
3. Modern Polarographic Methods by A.M. Bond, Marcell Dekker.
4. Electroanalytical chemistry by Basil H. Vessor & Galen W. Wiley Interscience.
5. Topics in pure and applied chemistry Ed. S.K. Rangrajan SAEST publications, Karaikudi, (India)
6. Techniques of Electro-organic synthesis Part I, II and III by N.L. Weinberg John Wiley Publication.
7. Organic Electrochemistry by M.M. Baizer Marcel Dekker.
8. Principles and applications of Electrochemistry By: D.R. Crow (Stanley Thrones (Pub.) Ltd.

CHY C06: CHEMICAL KINETICS - II

UNIT I

(a) Micelles Catalysis and Inhibition: Micelles and their classification, Kinetics and mechanism of micelle catalyzed reactions (1st Order and second order) Various type of micelle catalyzed reactions. Micelle inhibited reactions.

(b) Kinetics and Mechanism of Substitution Reaction: Classification of ligand substitution mechanism, anation and base catalysed Kinetics of anation reactions. Aquation and acid catalyzed Kinetics of aquation reactions (octahedral complexes).

UNIT - II

Radiation Chemistry-I

Radiation chemistry and Photochemistry. Radiation chemistry of water and aqueous solutions. Hydrogen atom and hydroxyl radical-oxidizing and reducing conditions. Kinetics and mechanism of photochemical and photosensitized reactions (one example in each case).

Stern-volmer equation and its application. Hole-concept in the presence of semiconductor photocatalysts. Kinetics and mechanism of electron transfer reaction in the presence of visible light. Kinetics of exchange reactions (mathematical analysis).

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UNIT - III

Induced Phenomena:

- (i) Metal ion catalyzed reactions, induced reactions, difference between the..... Kinetics of Induced reactions and their characteristics. Induction factor and its mechanistic significance. Mechanism of (i) Fe (II) induced oxidation of iodide by Cr (VI)
- (ii) As (III) induced oxidation of Mn (II) by chromate in acid solutions.
- (iii) Kinetics and mechanism of induced reactions in metal complexes (octahedral complexes of cobalt (III) only).

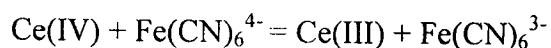
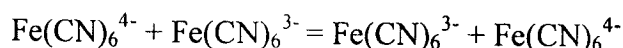
UNIT - IV

Electron Transfer Reactions in Metal Complexes:

Kinetics and mechanism of 1:1, 1:2 and 1:3 metal-substrate complexes as intermediates. Inner-sphere and outer-sphere reactions. Henry Taube's classical reaction. its kinetics and mechanism, experimental analysis by chromatographic and spectroscopic techniques.

Pattern of reaction via adjacent and remote attacks, linkage isomerism. Mechanism of inner sphere and outer sphere mode of electron transfer reactions.

Marcus - Cross-relation in outer-sphere reactions, (no mathematical derivation) in following reactions -



Bridged outer-sphere electron transfer mechanism.

SUGGESTED BOOKS AND REFERENCES

1. Progress ion inorganic chemistry, Vol. 30, 1967.
2. R. Lumry and R. W. Raymond, Electron Transfer Reactions, Interscience.
3. N. L. Bender, Mechanism of Homogeneous catalysis from protein to protein, Wiley.
4. A.G. Sykes, Kinetics of Inorganic Reactions, Pergamon.
5. Physical chemistry Vol. 2, Ed. Prof. Ya Grasimov, Mir Publisher.

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6. S.W. Benson, Mechanism of Inorganic Reactions, Academic Press.
7. Basolo and Pearson, Inorganic Reaction Mechanism, Wiley.
8. H. Taube, Electron Transfer Reactions, Oxford Press.

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