

# SCHEME OF EXAMINATION

&

## DETAILED SYLLABUS

For

**M.Sc. Chemistry**

**(W.e.f. 2019 – 2020)**



**KALINGA  
UNIVERSITY**

**FACULTY OF SCIENCE**

**Kalinga University, Atal Nagar, Chhattisgarh**

**MSC (Chemistry)- Session -2019-20**

**Semester I**

<b>Code No.</b>	<b>Paper</b>	<b>Credits</b>	<b>End Term</b>	<b>Internal Marks</b>	<b>Total Marks</b>
MCHM101	Inorganic Chemistry- I	4	70	30	100
MCHM102	Organic Chemistry- I	4	70	30	100
MCHM103	Physical Chemistry –I	4	70	30	100
MCHM104	Spectroscopy -1	4	70	30	100
MCHM105	Computers for Chemists	4	70	30	100
	<b>Practical</b>				
MCHM106P	Lab Course I (Inorganic Chemistry)	2	30	20	50
MCHM107P	Lab Course II( Physical Chemistry)	2	30	20	50
	<b>Total</b>	<b>24</b>	<b>410</b>	<b>190</b>	<b>600</b>

**Semester II**

<b>Code No.</b>	<b>Paper</b>	<b>Credits</b>	<b>End Term</b>	<b>Internal Marks</b>	<b>Total Marks</b>
MCHM201	Inorganic Chemistry- II	4	70	30	100
MCHM202	Organic Chemistry- II	4	70	30	100
MCHM203	Physical Chemistry –II	4	70	30	100
MCHM204	Spectroscopy –II	4	70	30	100
MCHM205	English language and communication skills	4	70	30	100
	<b>Practical</b>				
MCHM206P	Lab Course III (Analytical Chemistry)	2	30	20	50
MCHM207P	Lab Course IV (Organic Chemistry)	2	30	20	50
	<b>Total</b>	<b>24</b>	<b>410</b>	<b>190</b>	<b>600</b>

RAIPUR

**Semester III**

Code No.	Paper	Credits	End Term	Internal Marks	Total Marks
MCHM301	Natural product and Biochemistry	4	70	30	100
MCHM302	Environmental Chemistry	4	70	30	100
MCHM303	Organo -transition, Bioinorganic	4	70	30	100
	<b>Open Elective (Any One)</b>	4	70	30	100
MCHM304-A	Polymer Chemistry				
MCHM304-B	Analytical Chemistry				
	<b>Practical</b>				
MCHM306P	Lab Course V(Natural product/biochemistry )	2	30	20	50
MCHM307P	Lab Course VI(Environment /Polymer chemistry)	2	30	20	50
	<b>Total</b>	<b>20</b>	<b>340</b>	<b>160</b>	<b>500</b>

**Semester IV**

Code No.	Paper	Credits	End Term	Internal Marks	Total Marks
MCHM401	Industrial and fuel chemistry	4	70	30	100
MCHM402	Photo Chemistry	4	70	30	100
	<b>Open Elective(Any One)</b>	4	70	30	100
MCHM403-A	Medicinal and Pharmaceutical Chemistry				
MCHM403-B	Green and Nano chemistry				
MCHM403-C	Solid State and Material Chemistry				
MCHM404	<b>Project Work</b>	8	200		200
	Thesis				
	Power point presentation				
	<b>Viva</b>				
	<b>Total</b>				<b>500</b>
	<b>Grand Total</b>	<b>20</b>			<b>2200</b>

RAIPUR

**INORGANIC CHEMISTRY- I****Unit-I**

**Stereochemistry and Bonding in Main Group Compounds :** VSEPR, Walsh diagram (triatomic and pentatomic molecules), d -p bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. Spectroscopic ground states, The correlation of spectroscopic terms into mulliken symbols.

**Unit-II****Metal-Ligand Equilibrium in Solution & Magnetic Properties of Transition Metal Complexes**

Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by potentiometry , spectrophotometry, Bjerrum method , Job's and Mole ratio methods.

**Unit-III**

**Reaction Mechanism of Transition Metal Complexes &:** Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, anion reactions, reactions without metal ligand bond cleavage. Substitution reactions in square complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

**Unit-IV**

**Metal-Ligand bonding &:** Limitation of crystal field theory, molecular orbital theory for bonding in octahedral, tetrahedral and square planar complexes, -bonding and molecular orbital theory.

**Unit-V**

**HSAB Theory &, Optical Rotatory Dispersion and Circular Dichroism :** Classification of acids and bases as hard and soft; HSAB principle, theoretical basis of hardness and softness; Lewis-acid base reactivity approximation ,donor and acceptor . applications of HSAB concept.

Linearly and circularly polarized lights; optical rotatory power and circular birefringence, elasticity and circular dichroism ,ORD.

**Reference Book:**

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshaw, Pergamon.

4. Chemistry of the Elements. N.N. Greenwood and A. Earnshaw, Pergamon.
5. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
6. Magnetochemistry, R.1. Carlin, Springer Verlag.
7. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
8. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
9. Inorganic Chemistry, J.E. Huhey, Harper & Row.
10. Chemistry of the Elements. N.N. Greenwood and A. Earnshaw, Pergamon.
11. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
12. Magnetochemistry, R.1. Carlin, Springer Verlag.
13. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
14. Magnetochemistry, R.1. Carlin, Springer Verlag.



**ORGANIC CHEMISTRY****Unit-I**

**Nature of Bonding in Organic Molecules:** conjugation, cross conjugation, resonance, hyper conjugation, Aromaticity in benzenoid and non-benzoid compounds, Huckel's rule, annulenes, anti-aromaticity, homo-aromaticity, crown ether complexes and cryptands, inclusion compounds.

**Unit II**

**Stereochemistry :** Elements of symmetry, chirality, threo and erythro isomers, optical purity, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spirane chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

**Unit-III**

**Conformational analysis and linear free energy relationship:** Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity, conformation of sugars. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett equation and linear free energy relationship, Taft equation.

Reaction Mechanism : Structure and Reactivity Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, Hammond's postulate, Curtir-Hammett principle.

**Unit-IV**

**Aliphatic Nucleophilic Substitution :** The SN2, SN1 mixed SN1 and SN2 and SET mechanism. The neighboring group mechanism, neighboring group participation by p and s bonds, Classical and nonclassical carbocations, phenonium ions, norbornyl systems, ..The SN1 mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

**Unit V**

**Aromatic Electrophilic Substitution:** The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, Diazonium coupling, Vilsmeier reaction, Gatterman-Koch reaction

**Aromatic Nucleophilic Substitution:** The SNAr SN1, benzyne and SN1 mechanism, Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richter. Sommelet-Hauser, and Smiles rearrangements.

**Reference Book:**

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes,
4. Longman. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
9. Pericyclic Reactions, S.M. Mukherji, Macmillan,
10. India Stereochemistry of Organic Compounds, D.Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.

## PHYSICAL CHEMISTRY I

## UNIT-I

**Introduction to Exact Quantum Mechanical Results:** Schrödinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrödinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom and helium atom.

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

**Differential Calculus:** Functions: continuity and differentiability. Rules for differentiation. Application of differential calculus including maxima and basic rules for integration, integration by parts. Partial fraction and substitution, reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, curve sketching.

## Unit II

**Applications of Quantum Mechanics-**

MO theory of hydrogen molecule ion. Secular equation and its solution. Electron density distribution and stability of  $H_2^+$  ion. MO and VB theories of  $H_2$ . Resonance. MO theory of homonuclear diatomic molecules. Bond order and stability. MO theory of simple heterogeneous diatomic molecules like HF, LiH, CO and NO.

**Directed Valences and Ionic Bonding:** The hybridization, Bonding and hybridization involving d-orbitals. Ionic bonding and potential energy field. Lattice energy. Born theory and Born-Haber cycle. Electronegativity: Pauling, Mullikan. Electronegativity and percentage of ionic character. Secondary bond forces: The van der Waals' forces, ion-dipole, ion-induced dipole, dipole-dipole, dipole-induced dipole and London dispersion forces. The hydrogen bond.

## UNIT- III

**Molecular Orbital Theory:** Huckel theory of conjugated systems bond and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical cyclobutadiene etc. Introduction to extended Huckel theory.

**Angular Momentum:** Ordinary angular momentum, generalized angular momentum, eigenfunctions for angular momentum, eigenvalues of angular momentum operator using ladder operators addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

## UNIT- IV

**Classical Thermodynamics:** Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar free energy, partial molar volume and partial molar heat content and their significance. 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 for electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems; second order phase transitions.

## Unit-V

**Statistical Thermodynamics:** Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and micro-canonical 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. Application of partition functions. Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics distribution Law and

application to helium.

### Reference Book:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata Mc Graw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics. K.J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformation J. Rajaraman and J. Kuriacose, Mc Millan.
7. Micelles, Theoretical and Applied Aspects, V. M. Rao, Plenum.
8. Modern Electrochemistry Vol. 1 and Vol II J.O.M. Bockris and A.K.N. Reddy, Plenum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
10. Introduction to Quantum Chemistry-R.K. Prasad, New Age Publication.



RAIPUR



**SPECTROSCOPY- I****Unit-I**

**Principle of spectroscopy:** Electromagnetic radiation, interaction of electromagnetic radiation with matter absorption, emission, transmission, reflection, dispersion, polarization and scattering. Uncertainty relation & natural line width and natural broadening, transition probability, results of the time dependent perturbation theory, transition moment, selection rules, intensity of spectral lines. Born-Oppenheimer approximation, rotational, vibration & electronic energy levels

**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.

**Unit-II**

**Infrared-Spectroscopy:** Review of linear harmonic oscillator, 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, normal co-ordinate analysis.)

**Unit III**

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

**Molecular Spectroscopy:** Energy levels, molecular orbital, vibronic transitions, vibrational progressions and geometry of the excited states, Frank - Condon principle, electronic spectra of polyatomic molecules. Emission spectra, radiative and non-radiative decay, internal conversion, and spectra of transition metal complexes, charge- transfers spectra, Electronic spectra and application.

**Photoelectron Spectroscopy:** Basic principles, photo- electric effect, ionization process, Koopmans theorem, Photoelectron spectra of simple molecules. ESCA, chemical information from ESCA. Auger electron spectroscopy –basic idea.

**Unit IV****Raman Spectroscopy**

Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman spectroscopy (CARS)

**Unit V**

**Nuclear Magnetic Resonance Spectroscopy:** Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors, influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant "J" Classification (AXB, AMX, ABC, A2B2 etc.). spin decoupling; basic ideas about instrument, NMR studies of nuclei other than protin-13C, 19F and 31P. FT NMR, advantages of FT NMR

**Reference Book:**

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for chemical analysis d. H. Windawi and F.L. Ho, Wiley Interscience. NMR, NQR, EPr and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood. Physical Methods in Chemistry, R.S. Drago, Saunders College.
3. Chemical Applications of Group Theory, F.A. Cotton.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.
5. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
6. Introduction to Magnetic Resonance. A Carrington and A.D. Maclachalan, harper& Row.



RAIPUR

### Computers for Chemists

**Unit I:-** *Introduction to Computers and Computing.* Basic structure and functioning of computer with a PC as illustrative example. Memory I/O devices. Secondary storage Computer languages. Operating systems with DOS as an example Introduction to UNIX and WINDOWS. Principles of programming Algorithms and flow-charts.

**Unit II** *Computer Programming in* Elements of the compute language. Constants and variables. Operations and symbols Expressions. Arithmetic assignment statement. Input and output Format statement. Termination statements. Branching statements as IF or GO TO statement. LOGICAL variables. Double precession variables. Subscripted variables and DIMENSION. DO statement FUNCTION AND SUBROUTINE. COMMON and DATA statement (Student learn the programming logic and these language feature by hands on experience on a personal computer from the beginning of this topic.

**Unit III** *Programming in Chemistry.* Developing of small computer codes using any one of the languages C involving simple formulae in Chemistry, such as Van der Waals equation. Chemical kinetics (determination of Rate constant) Radioactive decay (Half Life and Average Life). Determination Normality, Molarity and Molality of solutions. Evaluation Electronegativity of atom and Lattice Energy from experimental determination of molecular weight and percentage of element organic compounds using data from experimental metal representation of molecules in terms of elementary structural features such as bond lengths, bond angles.

**Unit IV** *Use of Computer programmes.* Operation of PC. Data Processing. Running of standard Programs and Packages such as MS WORD, MS EXCEL -special emphasis on calculations and chart formations. X-Y plot. Simpson's Numerical Integration method. Programmes with data preferably from physical chemistry laboratory.

**Unit V** *Internet.* Application of Internet for Chemistry with search engines, various types of files like PDF, JPG, RTF and Bitmap. Scanning, OMR, Web camera.

#### Reference Book:

1. Fundamentals of Computer : V. Rajaraman, Prentice Hall.
2. Computers in Chemistry : K.V. Raman, Tata Mc Graw Hill).
3. Computer Programming in FORTRAN IV-V Rajaraman, Prentice Hall.
4. Computers and Common Sense, R. Hunt and J. Shelley, Prentice Hall.
5. Computational Chemistry, A.C. Norris.
6. Microcomputer Quantum Mechanics, J.P. Killngbeck, Adam Hilger.
7. An Introduction to Digital Computer Design, V. Rajaraman and T. Radhakrishnan, Prentice Hall.

**I. Qualitative and quantities analysis**

1. Qualitative analysis of mixture containing 08 radicals including two less common metals from among the following by semi micro method

Basic radicals:  $\text{Ag}^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Bi}^{3+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{As}^{3+}$ ,  $\text{Sb}^{3+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Hg}^{2+}$ .

Acid radicals: Carbonate, sulphide, sulphite, sulphate, nitrite, nitrate, acetate, chloride, fluoride, bromide, iodide, borate, oxalate, phosphate, silicate, thiosulphate, ferrocyanide, ferricyanide, chromate, arsenate and permanganate

2. Separation and determination of two metal ions involving volumetric and gravimetric methods.
3. Separation of cations and anions by Paper Chromatography.

**II. Preparations**

Preparation of selected inorganic compounds

1.  $\text{TiO}(\text{C}_9\text{H}_8\text{NO})_2 \cdot \text{H}_2\text{O}$
2.  $\text{cis-K}[\text{Cr}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O})_2]$
3.  $\text{Na}[\text{Cr}(\text{NH}_3)_2(\text{SCN})_4][\text{Fe}(\text{C}_2\text{O}_4)_3]$
4. Prussian Blue, Turnbull's Blue
5.  $[\text{Ni}(\text{NH}_3)_6] \text{Cl}_2$
6.  $\text{Ni}(\text{DMG})_2$
7.  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$
8.  $[\text{Co}(\text{NH}_3)_6][\text{Co}(\text{NO}_2)_6]$
9.  $\text{cis-}[\text{Co}(\text{trien})(\text{NO}_2)_2] \text{Cl} \cdot \text{H}_2\text{O}$
10.  $\text{Hg}[\text{Co}(\text{SCN})_4]$

**Reference Book-**

1. Vogel's Textbook of Quantitative Analysis Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.
3. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
4. 2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
5. 3. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
6. 4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier

R A I P U R

**MCHM107**

**Physical chemistry-Lab**

**ADSORPTION/SURFACE CHEMISTRY**

1. To Study Surface Tension - Concentration relationship for solutions (Gibbs equation).
2. To Verify the Freundlich and Langmuir Adsorption isotherms using acetic acid/Oxalic acid and activated charcoal.
3. Determination of CMC of surfactants.

**PHASE EQUILIBRIA**

1. To Construct the Phase diagram for three component system (e.g., chloroform-acetic acid-water).

**CHEMICAL KINETICS**

1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
2. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
3. Determination of the rate constant for the decomposition of hydrogen peroxide by  $\text{Fe}^{+++}$  and  $\text{Cu}^{++}$  ions.
4. 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).
5. Study of kinetics of exchange between ethyl iodide & the iodide ion.

**SOLUTIONS/MOLECULAR WEIGHTS**

1. Determination of molecular weight of non-volatile substances by Landsber
2. Determination of Molar masses of Naphthelene/acetanilid
3. Molecular weight of polymers by viscosity measurements.

**CONDUCTOMETRY**

1. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
2. Determination of solubility and solubility product of sparingly soluble salts (e.g.,  $\text{PbSO}_4$ ,  $\text{BaSO}_4$ ) conductometrically.
3. Determination of  $\text{pK}_a$  of Acetic acid and verification of Ostwald dilution law.

**POTENTIOMETRY/pH METRY**

1. Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.
2. Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.
3. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method.
4. Determination of Redox potential of  $\text{Fe}^{++}/\text{Fe}^{+++}$  system.

**POLARIMETRY**

1. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.
2. Enzyme kinetics –inversion of sucrose.
3. Determine the specific and molecular rotation of optically active substances.

To study the auto catalytic reaction between  $\text{KMnO}_4$  and Oxalic acid.

Reaction between  $\text{K}_2\text{S}_2\text{O}_8$  and Iodine.

#### Reference Book:

1. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
4. Handbook of Organic Analysis –Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry,
6. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
7. Findley's Practical Physical Chemistry, B.P. Levi
8. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
9. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
10. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
11. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.



RAIPUR



**SECOND SEMESTER-II**

**RAIPUR**

**INORGANIC CHEMISTRY- II****Unit-I****Electronic Spectral Studies of Transition Metal Complexes**

Term symbols for d-ions. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d1-d9 states), Jahn-Teller effect and electronic spectra of complexes. Selection rule for electronic spectroscopy. Intensity of various type electronic transitions. Calculations of  $10Dq$ , B and C parameters, charge transfer spectra.

**Unit-II**

**Magnetic Properties of Transition Metal Complexes:** Types of magnetic behavior, Diamagnetism, paramagnetism, Ferromagnetism and antiferromagnetism. Magnetic moment, L-S coupling, determination of ground state term symbol. Orbital contribution to magnetic moment, magnetic exchange coupling and spin crossover.

**Unit-III****Metal Carbonyl Complexes**

Metal carbonyl, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reaction of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

**Unit-IV****a. Metal Clusters**

Higher boranes, carboranes, metalloboranes and metallo-carboranes compound with metal multiple bonds.

**b. Rings:** Borazines, phosphazines.

**Unit-V****ISOPOLY ACID AND HETEROPOLY ACID**

Isopoly and heteropoly acids of Mo and W.

Preparation, properties and structure. Classification, Preparation, properties and structures of borides, carbides, nitrides and silicides. Silicates- classification and Structure, Silicones- preparation, properties and application.

**Reference Book:**

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshaw, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetochemistry, R.1. Carlin, Springer Verlag.



**ORGANIC CHEMISTRY-II****Unit-I**

**Addition Reactions** :Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, Addition to cyclopropane ring.Hydrogenation of double and triple bounds, hydrogenation of aromatic rings.Hydroboration, Michael reaction.

**Elimination Reactions:** The E2, E1 and E1 cB mechanisms and their spectrum. Orientation of the double bond.Reactivity-effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

**Unit-II**

**Pericyclic Reactions:** Molecular orbital symmetry, Classification of pericyclic reactions. Woodward-Hoffmann correlatinon diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions,  $4n$   $4n+2$  and allyl systems.Cycloadditions-antarafacial and suprafacial additions, . Sigmatropic rearrangements-suprafacial and antarafacial shifts of H, sigmatropic involving carbon moieties, 3,3- and 5,5 sigmatropicrearrangements. Claise n, Cope and aza-Cope rearrangements.

**UNIT- III**

**Rearrangements:** A detailed study of the following rearrangements

Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofman, Curtius, Schmidt, Baeyer-Villiger,

**Synthesis of Some Complex Molecules:** Application of the above in the synthesis of following compounds:Camphor, Longifoline, Cortisone, Reserpine, Vitamin-D, Juvabione.

**UNIT IV**

**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  $^1\text{H}$  NMRspectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

**UNIT-V**

**Small Ring Heterocycles.** Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, oxetanes and thietanes. *Benzo-Fused Five-Membered Heterocycles.* Synthesis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes.

**Reference Book:**

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes,
4. Longman, Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
6. Modern Organic Reactions, H.O. House,
7. Benjamin. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic &\* Professionalsl.
8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh,
9. Macmillan. Pericyclic Reactions, S.M. Mukherji, Macmillan,
10. India Stereochemistry of Organic Compounds, D. Nasipuri,
11. New Age International. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.



RAIPUR

**PHYSICAL CHEMISTRY-II****Unit-1**

**Chemical Dynamics:** 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 (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and homogeneous catalysis, 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 for unimolecular reactions).

**Unit-II**

**Surface Chemistry- 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).

**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-III**

**Macromolecules:** Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimension of various chain structures.

**Unit-IV**

**Non Equilibrium Thermodynamics:** Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electro kinetic phenomena, diffusion, electric conduction.

**Unit V**

**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. Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave

potential and its significance.

**Reference Book:**

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata Mc Graw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics. K.J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformation J. Rajaraman and J. Kuriacose, Mc Millan.
7. Micelles, Theoretical and Applied Aspects, V. M. Rao, Plenum.
8. Modern Electrochemistry Vol. 1 and Vol II J.O.M. Bockris and A.K.N. Reddy, Plenum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
10. Introduction to Quantum Chemistry-R.K. Prasad, New Age Publication.



RAIPUR

**SPECTROSCOPY- II****Unit-I**

**Electronic Spectroscopy & Molecular Spectroscopy:** Energy levels, molecular orbitals, vibronic transitions, vibration progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radio-active and non-radioactive decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

**Photoelectron Spectroscopy**

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

**Unit -II**

**Nuclear Quadrupole Resonance Spectroscopy:** Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splitting. Applications.

**Electron Spin Resonance Spectroscopy:** Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications.

**Atomic Absorption Spectroscopy and Atomic Emission Spectroscopy::**

Introduction, Principle, Classification, Measurement, Instrumentation, Origin of Spectra, Measurement, Instrumentation, Applications and Advantages & disadvantages.

**Unit-III**

**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.

**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.

**Neutron Diffraction** Scattering of neutrons by solids measurement techniques,

Elucidation of structure of magnetically ordered unit cells.

**Unit IV**

**Carbon- <sup>13</sup> NMR Spectroscopy:** - General consideration, chemical shift (aliphatic, olefinic, alkynes, aromatic, heteroaromatic and carbonyl carbon), coupling constant. Two dimension NMR spectroscopy- COSY, NOES, DEPT, APT and Inadequate techniques.

**Mass Spectroscopy:** Theory, instrumentation base peak, meta stable peak, fragmentation cleavage pattern, mclafferty rearrangement, ring rule, nitrogen rule and application and allylic and benzylic cleavage

**Unit V**

**Symmetry and Group theory in Chemistry:** 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  $C_n$ ,  $C_{nv}$ ,  $C_{nh}$ ,  $D_{nh}$  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

#### Reference Book:

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for chemical analysis d. H. Windawi and F.L. Ho, Wiley Interscience. NMR, NQR, EPr and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood. Physical Methods in Chemistry, R.S. Drago, Saunders College.
3. Chemical Applications of Group Theory, F.A. Cotton.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.
5. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
6. Introduction to Magnetic Resonance. A Carrington and A.D. Maclachalan, harper& Row.



RAIPUR

**English language and communication skills****UNIT-I**

The importance of communication through English at the present time,  
The process of communication and factors that influence communication sender, receiver  
channel, code, topic, message, context, feedback, noise, filters & barriers  
The importance of audience and purpose.

**UNIT-II**

The information gap principle: given and new information, information overload  
Verbal and non-verbal communication: body language, Comparing general communication and business  
communication

**UNIT-III**

Vowels, diphthongs, consonants, consonant clusters, The International Phonetic Alphabet (IPA): Phonemic  
transcription, Problem Sounds, Syllable division and word stress

**UNIT-IV**

Sentence rhythm and weak forms, Contrastive stress in sentences to highlight different words  
Intonation: Falling, rising and falling-rising tones, Varieties of Spoken English: Standard Indian, American and  
British

**UNIT-V**

Tense and aspect, Voice: Active and passive, Interrogation: reported and tag question, static and Dynamic  
Verbs, The auxiliary system: finite and non-finite verbs.

**Reference Book:**

- 1) An introduction to Professional English and Soft Skills by B. K. Das et al., Cambridge University Press .
- 2) Technical Communication: Principles and Practice, Second Edition by Meenakshi Raman and Sangeeta  
Sharma, Oxford Publications.
- 3) Effective Technical Communication by M Ashraf Rizvi, The McGraw-Hill companies.
- 4) Understanding Body Language by Alan Pease.
- 5) Communicative Grammar of English by Geoffrey Leech and Ian Svartik.
- 6) Better English Pronunciation by J.D.O'Connor.
- 7) English Grammar by S.Pit Corder
- 8) English Grammar by Wren and Martin.

Analytical chemistry-Lab

1. Error Analysis and statistical data analysis.

Errors, types of errors, minimization of errors, statistical treatment for error analysis, standard deviation, method of least squares. Calibration of volumetric apparatus, burettes, pipettes, standard flash, weight box etc.

- Determination of molecular composition of ferric salicylate /iron-phenanthroline/iron-dipyridyl complex by Job's method of continuous variation
- Determination of stability constant of Fe(III)-salicylic acid complex
- Preparation of Potassium Trioxalatoferrate (III) and estimation of Iron.
- Estimation of Ferrous Iron using 1,10 Phenolthroline by colorimetric method
- Estimation of Copper as Cuprammonium sulphate by Colorimetric method
- Estimation of Zinc using EDTA volumetrically
- Estimation of Magnesium using EDTA volumetrically
- Gravimetric estimation of Nickel using dioxime reagent
- Estimation of Ferric ion in the given sample of Haemetite
- Estimation of sulphate in a given sample as Barium sulphate
- a. Nano and Green /photochemistry**
- Preparation of Potassium tri-oxalato ferrate (III)  $K_3[Fe(C_2O_4)_3 \cdot 3H_2O]$ .
- To estimate the amount of Zinc using EDTA volumetrically.
- Estimation of copper cupraammonium sulphate by colorimetric methods
- To estimate amount of  $Fe^{2+}$  using 1,10- phenanathroline by colorimetric methods
- Preparation of Cis and Trans potassium oxalate diaqua chromate(III)  $K[Cr(C_2O_4)(H_2O)_2] \cdot 2H_2O$
- Synthesis of Ag Nano-particle by green synthesis.
- Synthesis of Zn Nano-particle by green synthesis.
- Synthesis of Cu Nano-particle by facile synthesis.
- Synthesis of Iron (Fe) Nano-particle using green tea leaves.
- Preparation of ZnO photocatalyst for rapid photocatalytic degradation.

Reference Books :

- Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
- Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
- Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

RAIPUR



## MCHM 107P

### Organic Chemistry -Lab

- 1. Qualitative Analysis:** Separation, purification and identification of compounds of Binary mixture using TLC and columns chromatography, chemical tests.
2. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
3. Estimation of amines/phenols using bromate bromide solution/or acetylation method.

#### Organic Synthesis:

4. Acetylation : Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.
5. Oxidation : Adipic acid by chromic acid oxidation of cyclohexaneol
6. Grignard reaction : Synthesis of triphenylmethanol from benzoic acid The Products may be Characterized by Spectral Techniques.
7. Aldol condensation Dibenzal acetone from benzaldehyde.
8. Sandmeyer reaction : p- Chlorotoluene from p-toluidine.
9. Acetoacetic ester Condensation : Synthesis of ethyl-nbutylacetoacetate .
10. Cannizzaro reaction : 4-Chlorobenzaldehyde as substrate.

**Preparation of Heterocyclic compounds:-** 1. Phenylhydrazine acetophenone phenylhydrazone 2-phenylindole Quinoline from Skraup synthesis

2. Benzaldehyde benzoin benzyl 2,3-diphenylquinoxaline Mixed principles
3. Aniline 2,4,6-tribromoaniline 2,4,6-tribromo-1-chlorobenzene
4. Phenol mixture of 2- and 4- nitrophenols separate 2- and 4- nitrophenols
5. Chlorobenzene 1-chloro-2,4-dinitrobenzene 2,4-dinitrophenylhydrazine

#### Quantitative Analysis

1. Determination of methoxy group.
2. Determination of vitamin C in drug formulations and in fruits.

#### Reference Books:

- Practical Organic chemistry by A. I. Vogel.
  - Practical Organic chemistry by Mann and Saunders.
  - Practical Organic chemistry by Garg and Salija.
  - The Systematic Identification of Organic compounds, R. L. Shriner and D. Y. Curtin.
  - Semimicro Qualitative Organic Analysis, N.D. Cheronis, J. B. Entrikin and E. M. Hodnett.
  - Practical Physical chemistry by Alexander Findlay.
  - Experimental Physical chemistry, D. P. Shoemaker, G. W. Garland and J. W. Niber, Mc Graw Hill
  - Interscience.
- Findlay's Practical Physical chemistry, revised B. P. Levitt, Longman. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J.
- Mendham, ELBS.
  - Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
  - Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
  - Systematic Qualitative Organic Analysis, H. Middleton, Edward Arnold.
  - Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Edward Arnold.
  - Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.



**THIRD SEMESTER**

**RAIPUR**

**Bio-Chemistry and Natural Product****UNIT- I**

**Metal ions in biological systems:** Essential and trace metals. Na<sup>+</sup>/K<sup>+</sup>Pump: Role of metal ions in biological processes.

**Bioenergetics and ATP Cycle:** DNA polymerisation, glucose storage, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, model systems. Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenase model systems.

**Electron Transport and Storage of Dioxygen:** Heme proteins and oxygen uptake, structure and function of Hemoglobin, Myoglobin, Hemocyanins and Hemerythrin, model synthetic complexes of Iron, cobalt and copper. electron transport process €cytochromes and Iron€sulphur proteins, synthetic models.

**UNIT II**

**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, reversible and irreversible inhibition. Mechanism of Enzyme Action

**Co-enzyme Chemistry:** Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological function of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD, NADP, FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors.

**UNIT III**

**Biological Cell and its constituents:** Biological cell, structure and function of proteins, enzymes, DNA and RNA in living systems, Helix coil transition. **Biopolymer Interactions:** Forces involved in biopolymer interaction, **Biopolymers** Polypeptide and protein structures, introduction to protein folding problem.

**Alkaloids:** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry and synthesis of the following: Ephedrine, (±) Conine, Nicotine, Atropine, Quinine and Morphine: Biosynthesis of alkaloids.

**UNIT IV**

**Terpenoids and Carotenoids:** Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry and synthesis of the following representative molecules: Citral, Geraniol, ...-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and †-Carotene. Biosynthesis of terpenoids.

**UNIT V**

**Steroids:** Occurrence, nomenclature, basic skeleton, Diels hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone. Biosynthesis of steroids.

**Plant Pigments:** Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Myrcetin, Quercetin-3-glucoside, Vitexin, Daidzein, Butein, Aureusin, Cyanidin-3, 5-diglucoside, Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

**Reference Book:**

Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.

Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.

Inorganic Biochemistry vols I and II. ed. G.L. Eichorn, Elsevier.

Progress in Inorganic Chemistry, Vols 18 and 38 ed. J.J. Lippard, Wiley.

Principles of Biochemistry, A. L. Lehninger, Worth Publishers.

Biochemistry, L. Stryer, W.H. Freeman.

Biochemistry, J. David Rawn, Neil Patterson.

Biochemistry, Voet and Voet, John Wiley.

Outlines of Biochemistry, E. E. Conn and P. K. Stumpf, John Wiley.

Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H. Dugas and C. Penny, Springer-Verlag.

Macromolecules: Structure and Function, F. Wolc, Prentice Hall.

**Reference Book:**

1. Natural Products: Chemistry and Biological Significance, J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthrope and J. B. Harborne, Longman, Essex.
2. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
3. Stereo selective Synthesis: A Practical Approach, M. Nogradi, VCH.
4. Roddf's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.

RAIPUR

## Environmental Chemistry

**UNIT-I Environment:** Introduction, Composition of atmosphere, vertical temperature, heat budget of earth atmospheric system, the Biogeochemical cycle of C, N, P, S and O.

**Atmosphere:** Chemical composition of atmosphere- particles, ions and radicals and their

formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N,C,S and their effect, pollution by chemicals, petroleum, chlorofluorohydrocarbons. Green house effect, acid rain, air pollution controls. Analytical methods for measuring air pollutants.

### UNIT-II

**Hydrosphere:** Chemical composition of water bodies-lakes, streams, rivers and wet lands etc. Hydrological cycle. Water pollutants and their effects. Aquatic pollution- inorganic, organic, agricultural, industrial and sewage, detergents, oil spills and oil pollutants, Water quality parameters € dissolved oxygen, biochemical oxygen demand, solids, content of chloride, sulphate, nitrate and nitrite, Water quality standards. Analytical methods for measuring metals (As, Cd, Cr, F, Pb, Hg, Se, Cu, Mn) Purification and treatment of water. General survey of instrumental technique for the analysis of heavy metals in aqueous systems.

### UNIT- III

**Soil and Environmental Disasters:** Soil composition, micro and macronutrients moisture, pH, total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkali, salts. Soil pollution by fertilizers, plastics and metals. Methods of re-mediation of soil. Bhopal gas tragedy, Chernobyl, Three Mile Island Sewazo and Minimata disasters.

**Natural Resources, Energy and Environment:** Mineral resources, Wood, Fuel and Energy resources: coal, petroleum and natural gas, Nuclear fission and Nuclear fusion, Solar energy, Hydrogen, Gasohol, World Energy Resources, Environmental management.

### UNIT- IV

**Industrial Pollution and Environmental Toxicology:** Cement, sugar, distillery, paper and pulp, thermal power plant, nuclear power plant, metallurgy, polymers, drugs, radionuclide analysis, disposal of wastes and their management. Chemical solutions to environmental problems, biodegradability, principles of decomposition, better industrial processes.

### UNIT-IV

#### **Environmental and Industrial law**

The Environmental Protection Act 1986, Powers of the Central Government, Parallel Provisions with the water and the Air act, The Public Liability Insurance Act 1991, Important rules & notification under the Environment Protection Act 1986.

Constitution of Central and State Pollution Control Boards, Power, Function and responsibility of Central and State Boards (Objectives, Area of jurisdiction, responsibility of an industry, power and function of state and central Government, Cognizance of offence, Penalties and Punishment), Biomedical waste (Handling and Disposal) rules 1998. Recycled plastic manufacture and usage rules 1999, Municipal Solid Waste (Management and Handling) Rules 2000, The Noise Pollution (Regulation and Control) Rules 2000, Environmental Impact Assessment Notification 2006, e-wastes Management and Handling Rules 2011.

### Reference Book:

1. Environmental Chemistry, Samir K. Banerji; Prentice Hall of India.
2. Environmental Chemistry, Sharma & Kaur; Krishna Publishes.
3. Environmental Chemistry, A. K. Dey, Wiley Eastern.
4. Chemistry of Atmosphere, R. P. Wayne; Oxford.
5. A Text Book of Environmental Chemistry and Pollution Control, S. S. Dara; S. Chand Publication.
6. Environmental Solution Analysis, S.M. Khopkar; Wiley Eastern.
7. Analytical Chemistry, G. D. Christian; J. Wiley
8. Environmental Solution Analysis, S.M. Khopkar; Wiley Eastern.
9. Principle of Instrumental Analysis, D. A. Skoog, J. L. Loary and W. B. Saunders
10. Basic Concepts of Analytical Chemistry, S.M. Khopkar; Wiley Eastern.
11. Analytical Chemistry, B. K. Sharma; Krishna Prakashan Media (P) Ltd. Meerut.
12. Environmental Science, Santra, Central
13. Pollution Control Acts, rules and Notifications issued under CPCB, New delhi
14. Environmental Laws, New Perspectives, K. C. Agrawal, Nidhi Publisher, Bikane
15. Environmental laws in India, Gurdip Singh, Quality Law Books



RAIPUR

**Organo-transition and Bioinorganic Chemistry****UNIT- I**

**Alkyls and Aryls of Transition Metals:** Types, routes of synthesis, stability and decomposition pathways, organo copper in organic synthesis.

**Compounds of Transition Metal-Carbon Multiple Bonds:** Alkylidenes, alkylidynes, low valent carbenes and carbynes-synthesis, nature of bond structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis.

**UNIT II**

**Transition Metal  $\pi$ -Complexes:** Transition metal  $\pi$ -complexes with unsaturated organic molecules, alkenes, alkynes, allene, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

**UNIT III**

**Transition Metals Compound with Bond to Hydrogen:** - Transition metal compounds with bonds to hydrogen. Fluxional Organometallic Compounds: - Fluxionality and dynamic equilibria in compounds such as  $\eta^2$ -olefin,  $\eta^3$ -allyl and dienyl complexes.

**UNIT IV**

**Homogeneous catalysis:** Stoichiometric reactions for catalysis homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), oxopalladation reactions, activation of C-H bond.

**Metal Storage Transport and Biomineralization:** Ferritin, transferrin, and siderophores

**Calcium in Biology:** Calcium in living cells, transport and regulation, molecular aspects of intramolecular processes, extra cellular binding proteins.

**UNIT V**

**Metalloenzymes:** Zinc enzymes  $\pi$ -carboxypeptidase and carbonic anhydrase, Iron enzymes  $\pi$ -catalase, peroxidase and cytochrome P-450. Copper enzymes- superoxide dismutase. Molybdenum oxotransferase enzymes  $\pi$ -xanthine oxidase. Coenzyme vitamin B<sub>12</sub>

**Metal• Nucleic Acid Interactions:** Metal ions and metal complex interactions. Metal complexes €nucleic acid.

**Metals in Medicine:** Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.

**Reference Book:**

1. Principles and Applications of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley
3. Metallo-organic Chemistry, A.J. Pearson, Wiley
4. Organometallic Chemistry, R.C. Mehrotra and A.Singh, New Age International
5. Principles of Bioinorganic Chemistry, S.J.Lippard and J.M.Berg. University Science Books
6. Bioinorganic Chemistry, I Bertono, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books
7. Inorganic Biochemistry vol. I and II ed. G.L. Eichhorn, Elsevier.
8. Progress in Inorganic Chemistry, Vol. 18 and 38 ed. J.J. Lippard, Wiley
9. Basic Experiment with radioisotopes by John, N. Andrews & David J. Hornsey, Pitam Publishing New
10. York.
11. Practical radiochemistry by M.F.C. Ladd & W.H. Lee, Cleaver Hune press Ltd.
12. Practical Physical Chemistry by Alexander Findlay.
13. Experimental Physical Chemistry, D.P. Shoemaker, C.W. Garland and J.W. Niber, Mc Graw Hill
14. Interscience.
15. Findlay's Practial Physical Chemistry, revised B.P. Levitt, Longman.



RAIPUR



## OPEN ELECTIVE

MCHM 304-A

External Marks: 70

Internal Marks: 30

### POLYMER CHEMISTRY

#### UNIT –I

**Basics of polymers:** Introduction to Polymers: An introduction to the history. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, free radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogenous and heterogeneous systems.

Polymerisation techniques such as - bulk, solution, suspension and emulsion polymerisation, Cationic and anionic polymerisation mechanism of ionic polymerisation, effect of gegen ions, temperature and solvent on polymerization, Copolymerisation, reactivity ratios, composition of copolymers, block and graft copolymers, Complex catalyst polymerisation,

#### UNIT-II

**Polymer Characterization:** Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distributions. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering. Osmotic and ultracentrifugation methods. Analysis and testing of polymers. Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

#### UNIT-III

**Structure and Properties:** Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point  $T_m$ -melting points of homogenous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. ATRP and Ring opening metathesis polymerization and their kinetics. The glass transition temperature  $T_g$ , Relationship between  $T_m$  and  $T_g$ , effect of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

#### UNIT-IV

**Polymer Processing:** Compounding. Processing techniques: Compression molding, transfer molding, injection molding, blow molding, reaction injection molding, die casting, rotational casting, film casting, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer, thermoforming, foaming, reinforcing and fibre spinning.

**Polymer testing:** Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress cracking resistance.

**Polymer Technology:** Plastics, elastomers, fibers. Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, crosslinking and vulcanization, vulcanization kinetics.

#### UNIT-V

**Organic Polymer Chemistry I:** Systematic study of polymers with emphasis centered on those synthesized by step-growth polymerization and their kinetics such as -polyesters, polycarbonates, polyamides , polyimides, epoxy, phenolic resins, amino plastics, polyurethanes etc

**Organic Polymer Chemistry II:** systematic study of polymers with emphasis centered on those synthesized by addition polymerization and their kinetics such as- ethers, acetals, lactones, lactams.

**Importance of Polymers:** commercial polymers and its application.

#### Reference Book

1. Textbook of Polymer Sciences, F. W. Billmeyer Jr, Wiley.
2. Polymer Sciences, V. R. Gowariker, N. V. Vishwanathan and J. Sreedhar, Willey- Eastern.
3. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R. M. Ottanbrite.
4. Contemporary Polymer Chemistry, H. R. Alcock and F. W. Lambe, Prentice Hall.
5. Physics and Chemistry of Polymers, J. M. G. Cowie, Blackie Academic and Professional.
6. Charles E. Carraher, Polymer chemistry, 6th edn, Marcel Dckker, Brijbasi Art Pvt.Ltd, 2003.
7. F.W.Billmeyer, Jr., A Text Book of Polymer Science, John Wiley and Sons, New York, 1971.
8. V.R.Gowariker, N.V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age



RAIPUR

**Analytical Chemistry****Unit-I****Statistical tests and Error Analysis:**

Accuracy, precision, methods for expressing accuracy and precision, Errors, classification of errors and minimization of errors, significant figures and computation of mean deviation, Standard deviation, Coefficient of variation, Relative standard deviations, regression, variance and coefficient of variance. The least squares method for deriving calibration graph. Correlation coefficient. Limit of detection. Significance test : t-test and Chi-test , Rejection of a result.

**Unit-II****Spectrochemical and Thermal methods:**

**Spectrophotometry:** Quantities principle of absorption, instrumentation, single beam, double beam, determination of pKa value of an Indicator and other applications.

**Atomic spectroscopy:** Principles of emission, atomic emission spectroscopy (AAS) and flame Photometry, types of interferences.

**Thermal methods of analysis:** principle and instrumentation of TGA and DTA. Complementary nature of TGA and DTA. Differential Scanning Calorimeter (DSC). Application of thermal methods in analytical chemistry.

**Unit-III****Electroanalytical Methods:**

**Titrimetric analysis its classification** – Acid base titration, Complexometric titration, Precipitation titration and Redox titration, Indicators theory of pH indicator,

**Gravimetric analysis-** theory and its application for estimation of transition metals. Theory of electrogravimetric analysis, electrode reactions, amperometry, over potential, cyclic voltammetry, Linear-Scan voltammetry, pulse Volta metric methods, stripping methods.

**Coulometry:** Basic principle

**Unit-IV****Separation Techniques:**

**Chromatography.** Theory of Chromatography. Classification of chromatography separation Retention time. Column resolution.

**Gas Chromatography.** Instrumentation. Columns. Detection: flame ionisation detector, thermal conductivity detector and mass spectrometric detector.

High-Performance Liquid Chromatography. Instrumentation. Pumping systems. Sample injection system.

**Columns. Detection:** UV-Vis detector, photodiode array detector, fluorescence detector and mass spectrometric detection.

**Adsorption and partition chromatography.** Ion exchange chromatography, cation and anion exchangers, Column and Detectors and their applications.

**Unit-V****Sample Preparation and Extraction Techniques:**

Sample Preparation for Chromatography. Solid-phase extraction, solid-phase microextraction. Extraction with molecular imprinted polymers.

**Solvent Extraction.** The distribution coefficient. Factors favouring solvent extraction. **Extraction reagents.** Synergetic effects. Ion-pair extraction. Extraction and stripping. Solvent extraction with crown ethers, and factors influencing it.

**Principle of analytical separation,** liquid-liquid extraction: distribution coefficient, distribution ratio, solvent extraction of metal, analytical separation, Microextraction and its types.

#### Reference Book

1. Gary D. Christian, Analytical chemistry, John-Wiley
2. H.A Willard, L.L. Merrit and J.A. Dean , Instrumental methods of analysis, van Norstand , New York, 1986
3. D.A. Skoog & D.M. West principles of instrumental Analysis: Holt Rinehart Winston, New York, 1988
4. K A Robinsons Chemical Analysis, Harper Collins Publisher, New York.
5. A.J. Bard and L.R. Faulkner, Electrochemical methods: Fundamentals and Applications, John Wiley & Sons: New York.
6. S.M. Khopkar, Basic concepts of analytical chemistry, Wiley Eastern, New Delhi.
7. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.



RAIPUR

## (Natural product/Biochemistry)-Lab

### 1. Volumetric Analysis

Determination of iodine and saponification values of oil samples

Determination of DO, COD, BOD, hardness of water samples.

### 2. Chromatography

Separation of cations and anions by paper chromatography, column chromatography.

3. Spectrophotometry: Verification of Beer's law. Molar absorptivity calculations, plotting graph to obtain  $\lambda_{\text{max}}$  etc. Determination of cations, anions and metal ions e.g. Na, K, Ca, SO<sub>4</sub>, NO<sub>2</sub>, Fe, Mo, Ni, Cu, etc.

4. Effect of pH in aqueous colored system.

Determination of metal ions e.g. Fe, Cu, Zn, Pb, etc. using inorganic reagent like SCN and organic chelating agent like dithiazone, cupferon, 8-hydroxyquinoline, etc in aqueous / organic phase in the presence of surface active agents.

### 5. Nephelometry / Turbidimetry

Determination of chloride, sulphate, phosphate, turbidity etc.

### 6. Industrial Chemistry

1. Estimation of available chlorine in bleaching powder.
2. Estimation of hardness of water.
3. Estimation of active matter content in a detergent.
4. Estimation of nitrogen in the fertilizer.
5. Estimation of phosphate in a superphosphate sample.
6. Estimation of potassium by flame photometric method.
7. Estimation of Iron (III) by colorimetry.

### Reference Book

Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS

Gary D. Christian, Analytical chemistry, John-Wiley

RAIPUR

## MCHM 307P

### (Environment/ Polymer chemistry)-Lab

#### 1. Bio-Inorganic Chemistry:

- (I) Extraction of chlorophyll from green leaves of student's of choice. Separation of chlorophylls and their electronics spectral study.
- (II) Complexation study of Cu (II) ion with biologically important amino acids.

#### 2. Multi step Synthesis of Organic Compounds

1. Beckmann rearrangement: Benzanilide from benzene (Benzene Benzophenone Benzophenoneoxime Benzanilide).
2. Benzilic acid rearrangement: Benzilic acid from Benzoin (Benzoin Benzil Benzilic acid)
3. Skraup's synthesis (Synthesis of heterocyclic compounds) Quinoline from o-amino phenol
4. m-nitroaniline from benzene (Benzene nitrobenzene m-dinitrobenzene m-nitroaniline)
5. Acridone from anthracitic acid (Anthracitic acid o-chlorobenzoic acid N-phenylanthranilic acid acridone).
6. Enzymatic synthesis: Enzymatic reduction: Reduction of ethylacetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ethyl-3-hydroxybutanoate and determine its optical purity. Biosynthesis of ethanol from sucrose.

#### 3. Extraction of Organic Compounds from Natural Sources

1. Isolation of caffeine from tea leaves.
2. Isolation of casein from milk: perform colour reaction of protein.
3. Isolation of nicotine dipicrate from tobacco.
4. Isolation of cinchonine from cinchona bark.
5. Isolation of piperine from black pepper.
6. Isolation of lycopene from tomatoes.
7. Isolation of  $\beta$ -carotene from carrots.
8. Isolation of limonene from citrus rinds.

#### 4. Nephelometric/ Turbidimetric Determination

1. Sulphate
2. Phosphate
3. Silver

#### 5. Chromatography

1. Separation and identification of the Sugars present in given mixture of glucose, fructose and sucrose by paper chromatography and determination of  $R_f$  values.
2. Thin - layer chromatography:- Separation of Ni, Mn, Co, and Zn and determination of  $R_f$  values.

#### Polymer Chemistry Practicals.

- 1.) Synthesis of caprolactum and Nylon-6.
- 2.) Preparation of Nylon-6,6 / -6,10 salt using HMDA- adipic acid/Sebasic acid.
- 3.) Preparation of P-F (Resole and Novalac), and U-F resin.
- 4.) Synthesis of styrene : Maleic anhydride copolymer.
- 5.) Synthesis of Adipic acid.
- 6.) Preparation of Bisphenol-A.
- 7.) Preparation of sodium carboxy methyl cellulose/starch.
- 8.) Preparation of chloro methylated/sulfonated polystyrene.
- 9.) Synthesis of Hexamethylene dimine by oxidative hydrolysis of Nylon-6,6.
- 10.) Synthesis of terephthalic acid from p-xylene.

## Reference Book

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
2. Gary D. Christian, Analytical chemistry, John-Wiley



RAIPUR



**FOURTH SEMESTER-IV**

**RAIPUR**



**FUEL AND INDUSTRIAL CHEMISTRY****UNIT-I**

**Fuels. Fossil fuels-** classification and unique features- Coal, Petroleum, natural gas. Biofuels: Biomass-biodiesel. Nuclear fuels: for various types of nuclear reactors. Hydrogen as fuel in the future, Hydrogen storage materials. Fuel cells – basic principle.

**Fuel Chemistry Review of energy sources** (renewable and non-renewable). Classification of fuels and their calorific value.

**(a) Coal:** Uses of coal (fuel and non fuel ) in various industries, its composition, carbonization of coal.Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro Gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

**UNIT II**

**Petroleum and Petrochemical Industry:** Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum

**Gaseous fuels:** Natural gas and gobar gas: production, composition and uses., Gobar electric cell. non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels

**UNIT-III : Water treatment**

Introduction Sources of water. Hardness of water-temporary or carbonate hardness, permanent hardness or non-carbonate hardness. Units of hardness, disadvantages of hard water – In domestic, in industry and in steam generation in boilers. Effect of iron and manganese in water. Estimation of hardness – EDTA method – Estimation of total hardness – O. Hehner's method or alkali titration method.

Water softening methods Industrial purpose Lime – soda process, Zeolite process; Ion-exchange - Demineralisation - deionisation process. Mixed – bed deionisation. Domestic purpose Removal of suspended impurities. Removal of microorganism – Chlorination . Break point chlorination. Reverse osmosis. Desalination. Waste water treatment

**UNIT IV**

**Lubricants:** Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pour point) and their determination.

**Oils and Fats** Classification of oils, fat splitting, distillation of completely miscible and nonmiscible oils, hydrogenation of oils, rancidity, saponification value, iodine number, acid value, Soap and Synthetic Detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS), detergent binders and builders.

Oils, fats, waxes and soaps

### **UNIT-V: Industrial Applications**

Sugar industry, Glass, Cement, Dyes, Paints, Special paints, Refractories, Abrasives, Plastics, Perfumes and flavoring industries, Fermentation industries, Explosives, Pulp and paper industries, Rubber industries, Pharmaceutical industries, Food and food products industries, Ceramic industries

### **References books**

1. Chemical Process Industries – Norrish Shreve, R. and Joseph A. Brink Jr. McGraw Hill, Industrial Book Company, London.
2. Production and Properties of Industrial Chemicals – Brain A. C. S. Reinhold – New York.
3. Petroleum Products Hand Book. Guthrie V., McGraw Hill, Tokyo.
4. Industrial Chemistry (Including Chemical Engineering) – B. K. Sharma (10th Edition )
5. Outlines of Chemical Technology – For the 21st Century – M. Gopala Rao & Matshall Sittig (3rd Edition)
6. Source Book on Atomic Energy by S. Glasstone



RAIPUR

## Photochemistry

### Unit-I

**Basis of Photochemistry:** Absorption, excitation, photochemical laws, quantum yield, electronically excited states life times-measurements of the times. Energy dissipation by radiative and non-radiative processes, absorption spectra, Franck-Condon principle, photochemical stages- primary and secondary processes.

**Properties of Excited States:** Structure (geometry), dipole moment, Photochemical kinetics-calculation of rates of radiative processes. Bimolecular deactivation- quenching.

### Unit-II

**Excited State of Metal Complexes:** Excited State of Metal Complexes: comparison with organic compounds, electronically excited states of metal complexes, charge-transfer spectra, charge transfer excitations.

**Ligand Field Photochemistry:** Photo substitution, photo oxidation and photo reduction, 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-III

**Redox reactions by Excited Metal Complexes:** Energy transfer under conditions of weak interaction and strong interaction-exciplex and Excimer formation; excited electron transfer, metal complexes as attractive candidates (2,2-bipyridine and 1,10-phenanthroline complexes), illustration of reducing and oxidizing character of Ruthenium<sup>2+</sup>(bipyridal complexes), Application of redox processes of electronically excited states for catalytic purposes, chemical energy into light (Chemiluminescence).

**Metal Complexes Sensitizers:** Metal complex sensitizer, water photolysis, and nitrogen fixation and carbon dioxide reduction.

**Photonuclear Reactions:-** High energy photonuclear reactions, special features of photonuclear reactions.

### Unit-IV

#### Photochemistry of alkene

Intramolecular reaction of the olefinic bond geometrical isomerism cyclisation reactions rearrangement of 1,4 and 1,5 dienes

**Photochemistry of Carbonyl Compounds:** Isomerisations, Additions and Substitutions

### Unit-V

#### Photochemistry of Carbonyl Compounds

Norrish Type I and II process, Intramolecular reactions of carbonyl compounds –saturated, cyclic and acyclic, - unsaturated and, unsaturated compounds, cyclohexadienones. Intermolecular cycloaddition reactions- dimerisations and oxetane formation

#### Miscellaneous Photochemical Reactions

Photo-Fries of anilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reaction. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.

Photoaddition of aromatic Compounds, Photochemical aromatic substitution.

**Reference:**

Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.

Inorganic Photochemistry, J. Chem. Educ., vol. 60, no. 10, 1983.

Progress in Inorganic Chemistry, vol. 30, ed. S.J. Lippard, Wiley.

Coordination Chem. Revs., 1981, vol. 39, 121, 131; 1975, 15, 321; 1990, 97, 313.

Photochemistry of Coordination Compounds, V. Balzani and V. Carassiti, Academic Press.

Elements of Inorganic Photochemistry, G. J. Ferraudi, Wiley.

**Books Suggested**

A Gilbert and J Baggott, Essentials of Molecular Photochemistry, Blackwell Scientific Publication.

J Coxon and B. Holtom, Organic Photochemistry, Cambridge University Press.

C H Dupuy and O L Chapman Molecular Reactions and Photochemistry, Prentice Hall

Photo chemistry chemistry , Alka L Gupta.



RAIPUR

**Medicinal and Pharmaceutical Chemistry****UNIT I**

**Drug Design:** Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure-activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship (QSAR). History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug receptor interactions. Physico-chemical parameters; lipophilicity, partition coefficient, electronic ionization constants, steric, Shelton and surface activity parameters and redox potentials. Free-Wilson analysis, Hansch analysis, relationships between Free-Wilson and Hansch analysis. LD-50, ED-50 (Mathematical derivations of equations excluded).

**UNIT II**

**Pharmacokinetics:** Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.

**Pharmacodynamics:** Introduction, elementary treatment of enzyme stimulation, enzyme inhibition. Sulphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation. Significance of drug metabolism in medicinal chemistry.

**UNIT III**

**Antineoplastic Agents:** Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors.

Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurine. Recent development in cancer chemotherapy. Hormone and natural products.

**Cardiovascular Drugs:** Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function. Central intervention of cardiovascular output. Direct acting arteriolar dilators.

Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol, oxyprenolol.

**UNIT IV**

**Local Antiinfective Drugs:** Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutal, fluconazole, econazole, Griseofulvin, chloroquin and primaquin.

**Antibiotics:** Cell wall biosynthesis, inhibitors,  $\beta$ -lactam rings, antibiotics inhibiting protein synthesis, Synthesis of penicillin-G, penicillin-V, ampicillin, amoxycillin, chloramphenicol, cephalosporin, tetracycline and streptomycin.

**UNIT V**

**Psychoactive Drugs-** The Chemotherapy of Mind: Introduction, neurotransmitters, CNS depressants, general

anesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazepines, buspirone, neurochemistry of mental diseases. Antipsychotic drugs- the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs. Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximide, trimethadione, barbiturates, thiopental sodium, glutethimide.

### Reference book

1. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas. Ed. Kurt Hostettmann, M. P. Gupta and A. Marston, Harwood Academic Publishers.
2. Introduction to Flavonoids, B. A. Bohm, Harwood Academic Publishers.
3. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
4. Insecticides of Natural Origin, SukhDev, Harwood Academic Publishers.
5. Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH.
6. Wilson and Gisvold's Text Book of organic Medicinal and Pharmaceutical Chemistry, Ed Robert F. Dorge.
7. An Introduction to Drug Design, S. S. Pandeya and J. R. Dimmock, New Age International.
8. Burger's Medicinal Chemistry and Drug Discovery, Vol. 1 (Chapter-9 and Ch-14), Ed. M. E. Wolff, John Wiley.
9. Goodman and Gilman's Pharmacological Basis of Therapeutics, Mc Graw-Hill.
10. The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.
11. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley.

**MCHM 403(B)**

**External Marks: 70**

**Internal Marks: 30**

### Green and Nan chemistry

#### Unit I

##### Introduction Nano Science

Introduction and definition of nanoparticles and nanomaterials, emergence of nanotechnology, Challenges of nanotechnology. Nanotechnology in relation to other branches of science. Structure of solids: crystalline and non-crystalline. Types of common materials and advanced materials inorganic, organic, biological. Types of nanomaterials depending upon their properties:

## Unit II

Preparation techniques and Applications: Various Preparation techniques in nanoscience synthesis-ceramic methods, solid solution, solgel, spray, pyrolysis, and combustion, electrosynthesis. Preparation of nanoscale materials, Applications Nanotechnology in modern technology in relation to electronic, biological, consumer and domestic applications. Energy related application: photo-volatile cells. Energy storage nanomaterials. Sensors: Agriculture, health and medical, food, security. Applied nanobiotechnology and nanobiomedical science drug delivery, drug targeting, biosensors, bioimaging, neutron capture therapy.

## Unit III

Basic Principles of Green Chemistry:- Prevention of waste by products, maximum incorporation of the reactants into the final product, prevention or minimization of hazardous products, designing safer chemicals, energy requirements for synthesis, selection of appropriate solvent, selection of starting materials, use of protecting groups, use of catalyst, products designed to be biodegradable, designing of manufacturing plants & strengthening of analytical techniques.

## Unit IV

Green Reagent

Dimethylcarbonate, polymer supported reagent, polymer supported peracids, poly(eric thioanisoyl resin). Poly-N-bromosuccinimide (PNBS), sulfonazide polymer, polystyrene Wittig reagent & polymer supported peptide coupling agent.

## Unit V

Green Catalyst

Acid catalyst, oxidation catalyst, basic catalyst, polymer supported catalyst, polystyrene – aluminium chloride, polymer supported photosensitizers, miscellaneous illustration & solid support reagents.

### Suggested Readings:

1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamlaya Publishers (2005).
2. P.T. Anastes & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press (1998).
3. A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).
4. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
5. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).
6. G.Zhong Cao. Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press (2004).
7. Introduction to nanotechnology, C. P. Poole Jr, F. J. Owens, 2nd edition, Wiley-India, Delhi, 2008.
8. Nanostructures and nanomaterials, G. Cao, Imperial College Press, University of Washington, USA, 2004.
9. Biomaterials, S. V. Bhat, 2nd edition, Narasa Publishing house, New Delhi, 2005.
10. Nanotechnology Fundamentals and applications, M. Karkare, I. K. international publishing house pvt. Ltd., Bangalore, 2008.
11. Nanomaterials: Synthesis, properties and applications, A. S. Edelstein, T. C. Cammarata, Inst. Of. Physics, UK, 1966.
12. Springer Handbook of Nanotechnology, B. Bhusan, 3rd edition, Springer-Verlag, 2009.
13. Chemistry of Nanomaterials: Synthesis, Properties and Applications, CNR Rao and T. Cheetham, Wiley & Sons, 2005.
14. Encyclopedia of Nanotechnology, Hari Singh Nalwa, American Scientific Publishers, 2004.

**MCHM 403(C)**

**External Marks: 70**

**Internal Marks: 30**

## SOLID STATE AND MATERIAL CHEMISTRY

### UNIT - I

**Structure and Imperfections:** Crystal symmetry, point groups, space groups, indices of planes, close packing in solids, bonding in materials, coordination and radius ratio concepts, point defects, dislocations, grain boundaries, surface energy and equilibrium shapes of crystals.

crystalline and amorphous. Unit cell, Bravais lattices and X-ray structure determination (NaCl and KCl only) – powder and single crystal- methods and applications-identification of the cubic lattice and indexing of the X-ray diffraction lines.

Radius ratio rules – Coordination number. Packing arrangement -different structure types in solids – rock salt, zinc blende, wurtzite, fluorite and antiferite, spinel and inverse-spinel and perovskite structures.

## UNIT-II

**Liquid Crystals:** Mesomorphic behavior, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic-nematic transition and clearing temperature-homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

**Ionic Conductors:** Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors.

## UNIT-III

**Processing of Materials and Characterisation Techniques:** Ceramic method, sol-gel, hydrothermal, high pressure, zone refining, CVD, Czochralski and Bridgman and Stockbarger methods.

Powder synthesis, sintering, chemical methods, crystal growth techniques, zone refining, preparation of nanoparticles and thin films. X-ray diffraction, spectroscopic techniques like UV-vis, IR, Raman. Optical and Electron microscopy. Thin film and Langmuir-Blodgett Films

## UNIT IV

**Thermodynamics and Kinetics:** Phase rule, phase diagrams, solid solutions, invariant reactions, lever rule, basic heat treatment of metals, solidification and phase transformations, Fick's laws of diffusion, mechanisms of diffusion, temperature dependence of diffusivity.

## UNIT-IV

**Mechanical Properties of Materials:** Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture, Electronic Properties: Free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric behaviour, piezo, ferro, pyroelectric materials.

## UNIT-V

**Magnetic Properties:** Origin of magnetism in metallic and ceramic materials, paramagnetism, diamagnetism, ferro and ferrimagnetism.

**Thermal Properties:** Specific heat, thermal conductivity and thermal expansion, thermoelectricity.

**Optical Properties:** Refractive index, absorption and transmission of electromagnetic radiation in solids, electrooptic and magneto optic materials, spontaneous and stimulated emission, gas and solid state lasers

**Multiphase Materials:** Ferrous alloys; Fe-C phase transformations in ferrous alloys; stainless steels, non-ferrous alloys, properties of ferrous and non-ferrous alloys and their applications

## UNIT-V

### Material types

**Superconductivity** – Introduction, Meissner effect – mention of Bardeen, Cooper and Schrieffer theory and Cooper pairs – examples of superconducting oxides, Chevrel phases – applications of superconducting materials. **organic superconductors**, magnetism in organic materials. Fullerenes-doped, fullerenes as superconductors. Molecular rectifiers and transistors, artificial synthetic devices, optical storage memory and switches-sensors.



**Ionic conductors** – Sodium- alumina, sodium-sulphur battery. Intercalation – layered compounds – graphitic compounds. Special applications of solid state materials. High energy battery, lithium cells.

metal, ceramic, Environmental Degradation: Corrosion, oxidation and prevention

1. Solid State Chemistry-An Introduction by Lesley Smart and Elaine Moore, Chapman Hall, London, 1992.
2. Solid State Chemistry by M. G. Arora, Anmol Publications, New Delhi, 2001. Dept of Chemistry, Loyola College (Autonomous), Ch-34, B. Sc (Chem) Syllabus 45.
3. Materials Science by P. K. Palanisamy, Scitech Publications, Chennai, 2003.
4. Modern Inorganic Chemistry by W. L. Jolly, Mc Graw Hill Book company, NY, 1989.
5. Inorganic Chemistry by D. F. Shriver and P. W. Atkins, Longford, Oxford University press, 1990.
6. Introductory Solid State Physics by H. P. Meyers, Viva Books Private Limited, 1998.
7. Solid State Chemistry and its applications by A. R. West, John-Wiley and Sons, 1987.
8. Modern aspects of Inorganic Chemistry by H. J. Emelius and A. G. Sharpe, Universal Book Stall, 1989.
9. Ionic crystals, Lattice defects and Nonstoichiometry, N. N. Greenwood, Butterworths, London, 1968.
10. Solid State Physics by Charles Kittel, John-Wiley and sons, NY, 1966.



RAIPUR