

Institute for Excellence in Higher Education (IEHE), Bhopal

PREVIOUS

Semester: II

CHEMISTRY

PAPER: I

III Application of Spectroscopy to Structural Analysis

Maximum Marks: 140

SYLLABUS

1. **Ultra-Violet Spectroscopy:** Absorption of dienes, polyenes, carbonyl compounds, α , β unsaturated carbonyl compounds and aromatic compounds, Woodward Feiser rule & its applications.
2. **Infrared Spectroscopy:**
 - (A) Vibration modes & bond stretching, absorption of common functional groups, electrical & steric effects, effects of hydrogen bonding, fingerprint region & interpretation of IR spectra. Applications of vibrational spectroscopy for investigating mode of bonding of ambidentate ligands (thiocyanate, nitrate, sulphate & urea).
 - (B) **Raman Spectroscopy:** Classical & quantum theories of Raman effect. Pure rotational, vibrational & vibrational-rotational Raman spectra, selection rule, mutual exclusion principle. Resonance Raman Spectroscopy, Coherent Antistokes Raman Spectroscopy (CARS) Comparison of IR & Raman Spectroscopy.
3. (A) **PMR Spectroscopy:** Interpretation of spectra, chemical shift, shielding mechanism & anisotropic effects, chemical exchange & chemical shift in chiral molecules, Spin-spin interaction, naming spin system, magnitude of coupling constant: geminal, vicinal & long range couplings, Second order spectrum & analysis of AB, AMX & ABX systems. Simplification of Complicated Spectra - Aromatic induced shifts, spin decoupling, deuterium exchange, spectra at higher fields, Hindered rotation & rate processes.
- (B) Lanthanide shift reagents, ^1H NMR of paramagnetic substances, COSY, NOESY, HETCOR
- (C) **CMR Spectroscopy:** General consideration, chemical shift, coupling constants, Off resonance decoupling, DEPT, Interpretation of simple CMR spectra.

4. **MASS Spectroscopy**

- (A) Introduction, ion production, fragmentation, factors influencing ion abundance, single & multiple bond cleavage, rearrangement, cleavage associated with common functional groups, molecular ion peak, metastable ion peak, Nitrogen rule & interpretation of mass spectra.
- (B) Fingerprint application & the interpretation of mass spectra, effect of isotopes on the appearance of mass spectrum, recognition of the molecular ion peak, Ionization techniques (EI & FAB).

5. **Symmetry and Group theory in chemistry**

Symmetry elements and symmetry operation, definition of group, subgroup, Conjugacy relation and classes, point symmetry group, Schoonflies symbols, representation of groups by matrices (representations 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, derivation of character table for C_{2v} and C_{3v} point group, symmetry aspects of molecular vibrations of H_2O molecule. Symmetry & shapes of simple AB_2 , AB_3 , AB_4 molecules on the basis of IR spectral data

Books Suggested

1. *Inorganic Electronic Spectroscopy* - A.P.B. Lever, Elsevier
2. *Structural Methods in Inorganic Chemistry* - E.A.V., Ebsworth, D.W.H., Rankin and S. Craddock, ELBS
3. *Infrared and Raman Spectra - Inorganic and Coordination Compounds* - H. Nakamoto, Wiley
4. *Basic Principle of Spectroscopy* - R. Change, McGraw Hill
5. *NMR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry* - R.V. Parish, Ellis Horwood
6. *Chemical Application of Group Theory* - F.A. Cotton, 3rd Edn., John Wiley & Sons, New York
7. *Inorganic Chemistry* - G.L. Miessler & D.A. Tarr, 2nd Edn., Prentice Hall International Inc., London
8. *Symmetry and Spectroscopy of Molecules* - K. Veera Reddy - New Age International Pvt. Ltd., New Delhi
9. *Application of Spectroscopy of Organic Compounds* - J.R. Dyers, Prentice Hall
10. *Introduction of NMR Spectroscopy* - R.J. Abraham, J. Fishes & P. Loftus, Wiley
11. *Spectroscopic Methods in Organic Chemistry* - D.H. Williams, I. Fleming, Tata McGraw
12. *Spectroscopic Identification of Organic Compounds*, 6th Edition, John Wiley, New York

Institute for Excellence in Higher Education (IEHE), Bhopal

Previous

Semester: II

SUBJECT: CHEMISTRY

PAPER: II

Mathematics and Computers for Chemists

Max. Marks: 140

Part-A: Mathematics for Chemists

Max marks: 70

SYLLABUS

I. **Vectors and Matrix Algebra**

Vectors – dot, cross, triple product etc. Gradient, Divergence & Curl, Vector calculus, Gauss theorem, Divergence theorem etc.

Matrix Algebra – Addition & multiplications, inverse, adjoint & transpose of matrices.

II. **Differential Calculus**

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

III. **Integral Calculus**

Basic rules for integration, integration by parts, partial fractions & substitution, reduction formulae, application of integral calculus. Function of several variables, partial differentiation, co-ordinate transformations (e.g. cartesian to spherical, polar)

IV. **Elementary Differential Equation**

Order & degree of differential equation, first order linear differential equation: Homogeneous, exact & linear equation. Application to Chemical kinetics, quantum chemistry etc., Second order differential equation & their solution.

V. **Permutation & Probability**

Permutation & combination, Probability & probability theorems; Average, variance root mean square deviation, example from the kinetic gases etc; Curve fitting (including least square fit etc) with a general polynomial fit.

Books Suggested

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|--|---------------------------------------|
| 1. <i>The Chemistry Mathematics Book</i> | : E. Steiner, Oxford University Press |
| 2. <i>Mathematics for Chemistry</i> | : Doggett & Suicliffe, Longman |
| 3. <i>Mathematics for Physical Chemistry</i> | : F. Daniels, Mc Graw Hill |
| 4. <i>Chemical Mathematics</i> | : D.M. Hirst, Longman |
| 5. <i>Applied Mathematics for Physical Chemistry</i> | : J.R. Barante, Prentice Hall |
| 6. <i>Basic Mathematics for Chemistry</i> | : Tebbutt, Wiley |

Institute for Excellence in Higher Education (IEHE), Bhopal

Previous

Semester: II

CHEMISTRY

PAPER: II

Mathematics and Computers for Chemists

Part-B: Computers for Chemists

Max marks: 70

SYLLABUS**I. Introduction to Computer and Computing**

Basic Structure and functioning of Computers with a PC as an illustrative example. Memory, I/O devices. Secondary storage. Computer languages. Operating System with DOS as an example. Introduction to UNIX & WINDOWS. Data processing, Principles of programming. Algorithms & flow charts.

II. Computer Programming in C

Elements of the Computer language. Constants & variables, Operations & Symbols, Expressions, Arithmetic assignment statement, Operators.

Branching Statement – such as *if*, *ifelse*, nested *if-else*, ladder *if-else*.

Looping – *while*, *do-while* & *for*. Controls statements - *break*, *continue* & *goto*.

Functions – User defined function, returning a value from function, local and global variables, automatic variables, static variables, external variables, declaration of a function, recursion.

Array – Declaration and initialization of 1D & 2D array, String functions (*strcpy*, *strlen*, *strcmp* and *strcat*)

III. Programming in Chemistry by C Language

Development of small computer codes involving simple formula in chemistry such as solution of Vander Waal equation, pH titration, kinetics, radioactive decay. Evaluation of lattice energy & ionic radii from experimental data. Determination of normality, molarity, molality of solution. Electronegativity of atom. Linear simultaneous equation to solve secular within the Huckie theory.

IV. Use of Application Packages

Introduction to application packages such as MS-WORD, MS-EXCEL, special emphasis on calculation & chart formation and its interpretation (Trendline & Forecasting).

V. INTERNET

Application of INTERNET for Chemistry with search engines, downloading & uploading of files.

Books Suggested

1. *Fundamental of Chemistry* : P.K. Sinha, B.P.B Publication
2. *Programming in ANSI C* : E. Balagurusamy, Tata McGraw Hill
3. *Computation Chemistry* : A.C. Norris
4. *Fundamental of Computer* : V. Rajaraman, Prentice Hill
5. *Computer in Chemistry* : K.V. Raman, Tata McGraw Hill
6. *MS Office 2000* : Gini Counter, B.P.B. Publication

Institute for Excellence in Higher Education (IEHE), Bhopal

PREVIOUS

Semester: II

CHEMISTRY

PAPER: III

Instrumentation and Analytical Chemistry

Max. Marks: 140

SYLLABUS

I. SAMPLING:

Introduction, getting a meaningful sample, Sample preparation and types of samples.

A- *Air sample collection and analysis*: General consideration of size, rate, duration, storage. Techniques for gases and vapours, gas sampling vapours, static sensors, entrapment, real-time analysis.

B- *Liquid sample collection and analysis*: Methods discrete sampling, composite sampling, sampling pre-treatment, analysis.

C- *Solid sample collection*: Types (a) Bulk sample (b) stratified (segregated sample) (c) discrete unit.

II. SEPERATION METHODS:

Introduction. Classification of separation methods, Maximum capacities, Efficiency of separation methods.

A- *Liquid-Liquid extraction*: Distribution relationship, solvent extraction system. Liquid-Liquid extraction in hydrometallurgy, special extraction systems, Limitation of Liquid - Liquid extraction. Solid phase extraction.

B- *Membrane separation*: Driving force, physiochemical theory of membrane separation, membrane material. non-separation with applied pressure, ultrafiltration, Reverse osmosis. Dialysis. Electrodialysis.

C- *Electrophoresis*: Principle. Types: TLC, Gel electrophoresis, Capillary electrophoresis, Low voltage electrophoresis. Thin sheet electrophoresis.

III. CHROMATOGRAPHY:

Introduction, classification, principles of chromatographic separation.

A- Plane chromatography:

1. Paper chromatography.

2. TLC: Introduction, Types – 2D TLC, HPTLC.

B- Liquid Chromatography

1. *HPLC*: Principle, Equipment (mobile phase supply system, sample injection system, column, detector).
2. *Ion exchange*: Cation-anion exchange resin, effect of pH.
3. *Gas Chromatography*: Introduction, Types: Gas-Solid (adsorption), Gas-liquid (partition), Types of column, Capillary application.

IV: STATISTICAL TREATMENT OF ANALYTICAL DATA:

Limitation of analytical method, Classification system of error, Accuracy, Precision, mean and standard deviation, how to reduce systematic errors, Reliability of result, Confidence interval, Rejection of measurement, Confidence interval test of significance, Significant figure and computation – Statistical evaluation of data, Computation rule - Method for reporting analytical data, Student **t**-test, Paired **t**-test, Chi-square test.

V: INSTRUMENTATION:

Basic components of analytical instrument, principles of instrumentation, working of-

1. Refractometer
2. Colorimeter
3. Flame-photometer
4. Nephelometer
5. Turbidometer
6. Fluorimeter
7. Spectrophotometer
8. Thermo-gravimetric analysis Instrumental, TG curve
9. Atomic Absorption spectrophotometer

Books Suggested:

1. *Vogel's Textbook of Quantitative Chemical Analysis*: J. Mendham, R.C. Denney, Publisher-Pearson Education
2. *Quantitative Chemical Analysis*: Daniel C. Harries, Publisher: W.H. Freeman
3. *Analytical Chemistry*: B.K. Sharma, Publisher: Krishna Prakashan Media Pvt. Ltd
4. *Analytical Chemistry*: Gary D. Christian, Publisher: WSE Wiley
5. *Separation Method*: M.N. Shastri, Publisher: Himalaya Publishing House

Institute for Excellence in Higher Education (IEHE), Bhopal

PREVIOUS

Semester II

CHEMISTRY

PAPER IV

Polymer Science

Max. Marks: 140

SYLLABUS**I: Fundamental of Polymer**

Basic concept of Polymer and history of Polymers. Classification, functionality and chemical/microstructure of polymer. Degree of Polymerization, molecular weight distribution, amorphicity and crystallinity of Polymers, Glass transition temperature (T_g) of polymers. Chemistry and Kinetics of polymerization-chain polymerization (Free radical chain polymerization, Cationic polymerization, Anionic Polymerization), Step growth polymerization (Polycondensation).

II: Molecular Weight and Processing of Polymers

Number average molecular weight. Weight average molecular weight and viscosity average molecular weight of polymers. Molecular weight determination methods like osmometry, light scattering, sedimentation, viscometry, cryoscopy, ebulliometry, ultra centrifugation, end group analysis and GPC etc.

Effect of molecular weight of polymers on properties of polymers.

Polymer processing: Introduction to injection moulding techniques, extrusion techniques, rotational moulding techniques.

III: Thermoplastic Materials**Commodity Plastic**

Polyolefin - Polyethylene, LDPE, HDPE, LLDPE, HMHDPE,

Polypropylene - Homo-polymers, Copolymers.

Polystyrene & Styrene copolymers - Polystyrene, HIPS, ABS, Styrene Acrylonitrile

Vinyl plastics - Polyvinyl chloride

Acrylic plastics - Polymethyl Methacrylate, Polyacrylonitrile

Engineering Plastics

Polyamides - Nylons 6, 66, 610, 11, 12 etc.

Polyesters - Polyethylene terephthalate, polybutylene terephthalate, polycarbonate

Polyacetals - Polyoxymethylene

Fluoropolymers - Polytetrafluoroethylene

End user applications - case studies on applications in agriculture, building, electrical, electronics, industrial, packaging, medical, sports, transport, water management, telecommunication, toys etc.

IV: Testing and Characterization of Polymers

Importance of testing, physical (specific gravity, MVTR), mechanical (tensile, flexural, impact and hardness), thermal (MFI, HDT, VSP, Flammability) and electrical properties (surface and volume resistivity, arc resistance, dielectric strength, CTI) of polymers. identification of polymers by simple techniques.

Polymers characterization techniques like - FTIR, DSC, TGA, TMA and GPC.

V: Thermosetting Materials

Synthesis, properties and applications of Phenol Formaldehyde (PF Resin), Urea Formaldehyde Resin (UF Resin), Melamine Formaldehyde (MF Resin), Unsaturated Polyesters (UP Resin), Alkyd Resin, Epoxies Resin, Polyurethane and Silicon Resin.

An introduction to Composites Materials - Definitions, properties of resins, fibres (Carbon fibre, glass fibre, Kevlar Fibre), Method of preparation of composite materials.

An introduction to Polymer Blends and Alloys - Definitions, advantages of polymers blends and alloys, role of composition, compatibility, properties and applications.

An introduction to Nano Materials - Polymer nanocomposites, nanoclay, carbon nanotubes, fullerenes - their advantages and applications in polymeric materials.

Books Suggested:

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| 1. Plastic Materials (Ed-7) | : Brdson, J.A. |
| 2. Hand Book of Plastics Materials & Technology | : Rubin, Irwin, J |
| 3. Plastics Materials Hand Book | : Athalye, A.S. |
| 4. Polymer Science | : Gowarikar, V.R. & others |
| 5. Text Book of Polymer Science | : Billmeyer, F.W. |
| 6. Introduction to Nanotechnology | : Charles P. Pool Jr. & Frank J. Owens |
| 7. Plastics Engineering Hand Book (Ed-5) | : SPI, Society of the Plastic Industry Inc |
| 8. Plastic Materials and Processing | : Schwartz & Goodman |
| 9. Plastic Materials and Processing Application | : Birely & Scott |
| 10. Modern Plastic Hand Book | : Harper |

Institute for Excellence in Higher Education (IEHE), Bhopal

M.Sc. PREVIOUS

Semester: I

SUBJECT: CHEMISTRY

PAPER I

TITLE: Chemistry of Transition Metal Complexes

Max. Marks: 140

SYLLABUS

I. (A) *Metal-Ligand Bonding*

Limitation of crystal field theory, Molecular orbital theory for bonding in octahedral, Tetrahedral & square planar complexes.

(B) *Metal Ligand Equilibrium in Solution*

Stepwise & overall formation constant & their interaction. Trends in stepwise constant. Factors affecting the stability of metal complexes with reference to the nature of metal ions & ligands, chelate effect, Determination of binary formation constant by potentiometer & spectrophotometer.

II. *Reaction Mechanism-I*

Reactivity of metal complex, inert & labile complexes, Kinetic application of valence bond & crystal field theory, Kinetics of octahedral substitution reactions, acid hydrolysis, Factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism. Direct and Indirect evidences in favour of conjugate mechanism, Anation reactions, reactions without metal ligand bond cleavage.

III. *Reaction Mechanism-II*

Substitution reactions in square planar complex, Trans effect, mechanism of substitution reaction, Redox reaction, Electron transfer reaction, mechanism of one electron transfer reaction, outer sphere type reaction.

IV. (A) *Electronic Spectral Studies of Transition metal complexes*

Spectroscopic ground states, correlation Orgel & Tanabe-Sugana diagrams for transition metal complexes (d1-d9 states), selection rule for electronic spectroscopy. Intensity of various type electronic transitions. Calculation of Dq & B parameters, charge transfer spectra.

(B) *Magnetic properties of transition metal complex*

Magnetic property & determination of magnetic susceptibility, anomalous magnetic moments, quenching of orbital contribution, orbital contribution to magnetic moment, magnetic exchange coupling & spin cross over.

V. *Transitional metal π complexes*

Structure & bonding in metal carbonyl & nitrosyl compound. Transition metal π complexes with unsaturated organic molecules like alkenes, alkynes, allyl.

References:

1. *Advanced Inorganic Chemistry*, F.A. Cotton and Wilkinson, John Wiley.
2. *Inorganic Chemistry*, J.E. Huhey, Harpes & Raw.
3. *Chemistry of Elements*, N.N. Greenwood and A. Earnshaw, Pergamom.
4. *Magnetiochemistry*, R.J. Carlin, Springer Verlag.
5. *Comprehensive Coordination Chemistry*, G. Wilkinson, R.D. Gillars and J.A. Cleverty, Pergamom.



*Institute for Excellence in Higher Education (IEHE), Bhopal*M.Sc.: **FINAL**Semester: **III**SUBJECT: **CHEMISTRY**PAPER: **I****TITLE: Fundamentals of Pharmaceutical Chemistry**Maximum Marks: **140****SYLLABUS****1. Introduction to drugs**

Definition of pharmaceutical chemistry, Nature & source of drugs. Some important terminologies used in pharmaceutical chemistry-pharmacy, pharmacology, medicinal chemistry, pharmacodynamic, pharmacokinetics, molecular pharmacology, pharmacophore, antimetabolites, actinomycetes, chemotherapy, pharmacopoeia. Pharmacognosy, Pharmacotherapeutics, classification and nomenclature of drugs. prodrugs and soft drugs.

2. Drugs design

- (A) Development of new drugs, Drugs discovery without lead (eg. Penicillin). Concept of bio-active compounds, drug design, methods for Lead identification, Lead modification, SAR (Structure Activity Relationship). QSAR-Hansch equation, Hansh analysis method, free-Wilson analysis method.
- (B) Theories of drug activity-clark occupancy theory, occupation theory, rate theory, induced fit theory, Thermopeutic ratio (derivation, numerical excluded) physico-chemical parameters.

3. Pharmacokinetics

- (A) Definition, drug absorption, drug receptor interaction, basic ligand concept. agonist, antagonist, partial agonist, inverse agonist, drug distribution, drug elimination, drug disposition.
- (B) Introduction to Pharmacokinetic, parameters (volume of distribution, clearance, bioequivalence), factors governing volume of drug distribution factors affecting absorption. Bioavailability, use of pharmacokinetics in drug development process.



4. Pharmacodynamics

- (A) Definition, enzyme stimulation, enzyme inhibition, antidiabetic drugs- Introduction, mode of action of insulin & metformine.
- (B) Xenobiotics, detoxication - Definition, site of detoxication, mechanism of detoxication oxidation, reduction, hydroxylation, hydrolysis, conjugation, detoxication of cyanide, general introduction of toxicological study of drugs.

5. Storage & application

Factors affecting stability of medication on storage, temperature effect, humidity effect, effect of gases, effect of light, container, Encapsulation. Application of pharmaceutical chemistry

Books Suggested

1. *Fundamental Concept of Applied Chemistry* - Jayshree Ghosh.
2. *Medicinal Chemistry-Ashutosh*, New Age International Publishers.
3. *A Textbook of Pharmaceutical Chemistry* - Jayshree Ghosh.
4. *Foye's Medicinal Chemistry* - Lemke Williams.
5. *Pharmaceutical Chemistry Inorganic* - G.R. Chatwal, Himalaya Publishing House.
6. *Text Book of Biochemistry* - D.M. Vasudeven, J.P. Publication.
7. *Pharmacology* - H.P. Rang, M.M. Dalp, P.K. Moora, J.M. Ritter.



Institute for Excellence in Higher Education (IEHE), Bhopal

M.Sc.: PREVIOUS

Semester: I

SUBJECT: CHEMISTRY

PAPER: II

TITLE: Organic Chemistry- Reaction Mechanism

Maximum Marks: 140

SYLLABUS

1. Nature of bonding in organic compounds

- Concept of hybridization, sigma and pi bond, polar and steric effects (i) Types of bond cleavage (ii) Intermediates (iii) Reagents and (iv) Reactions.

2. Mechanism of chemical reactions involving carbocation intermediates/transition state:

- **Nucleophilic substitution at a saturating carbon atom (aliphatic):**

Types of mechanism $-SN^1$, SN^2 & SN^1 . Effect of (i) solvent (ii) structure (iii) entering and leaving group on proposed mechanism.

Kinetic and stereochemical studies (i) inversion (ii) racemisation (iii) retention of configuration –neighbouring group participation.

- **Electrophilic addition to $C=C$ & $C=C-C=C$ system**

Mechanism of addition with common addendum (X_2 , H_2 , HX , O_3 , Hydration, carbocation, hydroxylation) stereochemistry, orientation, reactivity of substituted substrate (effect of substitution on rate of addition).

Electrophilic substitution to benzene and its derivatives with reference to kinetic and thermodynamic control.

Energy profile diagrams, Directing influence of groups, O/P ratio, partial rate factors and selectivity.

- **Elimination reactions:**

α elimination; E-1, E-1cB and E-2 mechanism, Stereoselectivity, Orientation, Saytzeff vs. Hofmann; factors affecting Saytzeff and Hofmann elimination, Elimination vs. Substitution, effect of activating groups. 1, 1 (α) elimination.

- **Rearrangement at electron deficient atom:**

Carbocation rearrangement

- With change in carbon skeleton - Pinacole Pinacolone rearrangement
- Without change in carbon skeleton - Allylic rearrangement.
- Rearrangement to electron deficient nitrogen atom - Backmann rearrangement
- Rearrangement to electron deficient oxygen atom - Baeyer-villiger oxidation

3. Mechanism of chemical reactions involving carbanion intermediates/transition states:

- **Nucleophilic** addition $c=c$, $c=O$, $c=c-c=O$
- **Structure** and reactivity of carbonyl group, simple addition reactions, addition of alcohol, addition of carbanion to different carbonyl derivatives- Perkin, Knoevenagel and Stobbe, Claisen ester condensation, addition of electron, metal hydrides.
- **Addition to $c=c$, Cyanoethylation Michael reaction.**
- **Addition to $c=c-c=O$**
- **Nucleophilic substitution in aromatic compounds:**
Substitution of hydrogen and atoms other than hydrogen
- **Rearrangement to electron rich atom (electrophilic rearrangements)**
Wittig rearrangement.

4. Mechanism of chemical reactions involving free radical intermediates:

Addition to $>c=c<$: Halogen; hydrogen bromide; polymerization
 Substitution of alkanes: Halogenation

5(a) Organic photochemistry:

- Photochemical energy, electronic excitation, excited states, modes of dissipation of energy, energy transfer, intramolecular energy transfer, quantum efficiency.
- Photochemistry of carbon compounds, Norrish type I & II reactions; photochemical reactions of cyclic ketones, Paterno Buchi reaction. Photo-chemistry of α - β unsaturated ketones.
- Photochemistry of olefins-cis-trans isomerism, dimerisation, butadiene photochemistry.

5(b) Pericyclic reactions:**Conservation of molecular orbital symmetry, properties of molecular orbitals.**

- Electrocyclic reactions – correlation diagram and FMO method
Cyclobutene - butadiene and cyclohexadiene- hexatriene system.
- Cycloaddition reaction – correlation diagram and FMO method
Ethylene to cyclobutene system, ethylene and butadiene to cyclohexene system.
- Sigmatropic rearrangement : FMO method
Suprafacial and Antarafacial process, analysis of sigmatropic rearrangement Cope and Claisen rearrangements.

References

1. *A Guide Book to Mechanism of Organic Chemistry*, Peter Sykes, Pearson education.
2. *Advance Organic Chemistry*, F.A. Carey and R.J. Sundberg, Plenum.
3. *Advance Organic Chemistry – Reaction, Mechanism and Structure*, Jerry March and John Wiley.
4. *Organic Chemistry*, R.T. Morrison and R.N. Boyd, Prentice Hall.
5. *Reaction Mechanism in Organic Chemistry*, S.M. Mukerji and S.P. Singh, McMillan.
6. *Pericyclic Reactions*, S.M. Mukherji, McMillan, India.

Institute for Excellence in Higher Education (IEHE), Bhopal

M.Sc.: PREVIOUS

Semester: I

SUBJECT: CHEMISTRY

PAPER: III

TITLE: Physical Chemistry

Max. Marks: 140

SYLLABUS**I: Chemical Dynamics**

Methods of determining rate laws, collision theory of reaction rates, steric factors, activated complex theory. Arrhenius equation and the activated complex theory, ionic reactions, kinetic salt effect, steady state kinetics, kinetics and thermodynamic control of reaction, treatment of unimolecular reactions. Dynamic chain reaction (Hydrogen-Bromine, Hydrogen Chlorine, Pyrolysis of acetaldehyde, decomposition of ethane and oscillatory reactions). General features of fast reaction, study of fast reactions by flow method relaxation method, flash photolysis and nuclear magnetic resonance method, dynamics of unimolecular reaction (Lindemann Hinshelwood and Rice-Ramasberger-Kassel-Marcus (RRKM) theories for unimolecular reactions).

II: Classical Thermodynamics

Brief resume of the 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 significance. Determination of these quantities, Concept of Fugacity and determination of fugacity, non-ideal behavior.

III: Statistical Thermodynamics

Concepts of distribution, thermodynamic probability and most probable distribution, Ensemble averaging, postulation of ensemble averaging, canonical, grand canonical and micro canonical ensemble, Corresponding distribution laws (using Lagrange's method of undetermined multipliers) Partition function- translation, rotational, vibrational and electronic partition functions.



IV: Quantum Chemistry

- (A) **Fundamentals:** Review of Classical Mechanics, General formulations of quantum mechanics, Schrödinger equation and the postulates of quantum mechanics, Discussion of solutions of the schrodinger equation to sum model systems viz., particle in a box, the harmonic oscillator the rigid rotor, the hydrogen atom.
- (B) **Approximate methods:** The various theorems, linear variation principle, Application of variation method, Eigen value of angular momentum operations using ladders operators.

V: Electrochemistry

Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion solvent interaction, Debye-Huckel-Bjerrum mode, thermodynamics of electrified interface equation. Electro capillarity, lippmann equations (surface excess), methods of determination, structure of electrified interfaces, Overpotentials, exchange current density, derivation of Butler Volmar equation, tafel plot. Quantum aspects of charge transfer at electrodes-solution interface. Polarography theory, ilkovic equation, half wave potential and its significance.

Books Suggested:

1. *Physical Chemistry* : P.W. Atkins ELBS
2. *Chemical Kinetics* : K.J. Laidler, McGraw-Hill
3. *Physical Chemistry* : B.K. Sharma, Krishna Prakashan Media Pvt. Ltd.
4. *Physical Chemistry* : Gurdeep Raj
5. *Physical Chemistry* : Gurtu & Gurtu
6. *Physical Chemistry* : Gurdeep Raj and Harish
7. *Thermodynamics* : Glasston
8. *Kinetics & Mechanism of Chemistry Transformation*: J. Rajaraman & J. Kuriacose, Mc Millan.
9. *Physical Methods in Chemistry*: R.S. Drago, Saunders.
10. *Molecular Quantum Mechanics*: P.C. Atkins & R.S. Friedman.

Institute for Excellence in Higher Education (IEHE), Bhopal

M.Sc.: PREVIOUS

Semester: I

SUBJECT: CHEMISTRY

PAPER: IV

TITLE: **Chemical Hazard and Management**

Max. Marks: 140

SYLLABUS

I. *Understanding of Chemical Hazards:*

Understanding of Basic terms: Hazards, risk, vulnerability, Disasters

Types and characteristics of Chemical hazard: Fire, Explosion, toxic release

Hazardous Chemicals: Definitions and Categorization as per regulatory provisions

Hazardous properties and Safe handling of following Hazardous Chemicals: Chlorine, Sulphuric acid, Propane, Hydrogen Sulphide, Acetone, Liquefied Petroleum Gas.

II. *Fire and Explosion Hazards:*

Basic understanding of Fire and Explosion incidents, Initiating Factors for Fire and Explosions, Types of fire, Chemistry of fire, Industrial fire, Flash point, Auto ignition temperature, explosive limit, Extinguishing Agents, Water and its extinguishing properties Carbon dioxide and its extinguishing properties, Dry chemicals and dry powders and its extinguishing properties, Carbon tetrachloride and its extinguishing properties, Foam and its extinguishing properties, halogenated extinguishing agents, Fire protection equipment.

Types of Explosion: Basic understanding of Boiling Liquid Expanding Vapor Explosions and Vapor Cloud Explosions.

Case Study of San Juanico Disaster and Bhopal gas tragedy, sequence of events, the scale of disaster, failure of system, lessons of the disaster.

III. *Chemical Hazard Assessment:*

Basic concept of risk analysis for chemical accident, Methodology and basic Steps for risk assessment, Understanding of Domino effect

IV. *Hazardous waste management :*

Hazard information labeling system, TREM card, emergency information panel, Safety precaution in transportation of hazardous chemicals, Hazardous material emergency management codes. Case studies of accidents during transportation of hazards chemicals. Definition and characterization of Hazardous chemicals as per hazardous waste management rule 1989. Chemical, biological and thermal treatment of hazardous waste.

V. *Chemical disaster management*

Basic features of guidelines, responsibility of different stake-holders in Chemical emergency management

Books Suggested:

1. *Safe Handling of Hazardous Chemicals* – A.K. Rohatgi
2. *Chemical Hazards* – Lee (vol-1 and vol.- 2)

Institute for Excellence in Higher Education (IEHE), Bhopal

M.Sc. FINAL

Semester: III

SUBJECT: CHEMISTRY

PAPER: II

TITLE: Biochemistry

Max. Marks: 140

SYLLABUS

WATER, pH & BUFFER:

Water as a medium for biological reaction, concept of pH in terms of biological system, effect of pH on a biomolecules, biological buffers system.

Bonding in biomolecules - H-bond, vander waal interaction, ionic bond, hydrophobic attraction, glycosidic linkage, peptide bond, phosphodiester linkage

BIOENERGETICS:

Concept of energy, thermodynamic principles (without deviation), thermodynamics state function, high energy phosphate compounds, hydrolysis of phosphate bonds, redox potential, ETC, oxidative & substrate level phosphorylation.

METABOLISM OF BIOMOLECULES:

Carbohydrate Metabolism - Glycolysis, oxidation of pyruvate to acetyl CoA, Kreb's cycle, Gluconeogenesis, glycogenesis, glycogenolysis, HMP shunt.

Lipid - TG Hydrolysis, β Oxidation of FFA, Ketone bodies metabolism.

Amino Acid: Transamination, Deamination, Decarboxylation, formation of Urea.

ENZYMES:

Properties, classification & nomenclature, activation energy, transition state theory, concept of active site, theories for enzymes-substrate complex formation. Enzyme specificity. Metallo enzymes, Enzyme Inhibition.

Mechanism of Enzyme Carboxypeptidase, Ribonuclease, Chymotrypsin, Lysozyme.

Enzymes Catalysis: Acid-base catalysis, covalent catalysis with nature of catalysed and uncatalysed reaction.

Enzyme Kinetics: Michaelis-menten equation line weaver – Burk equation, kinetics for competitive, non competitive and uncompetitive inhibitor.

Bisubstrate reaction, enzyme isolation & purification, enzyme immobilization.

BIOCHEMICAL FUNCTIONS OF INORGANIC IONS:

Role of Ca^{2+} , K^{+} , Na^{+} , Mg^{2+} , Fe^{2+} in living system & their requirements and their application in biological system.

Book Suggested:

1. *Lehninger Principles of Biochemistry*: Nelson D.L. & Cox M.M. CBS Publication (2000).
2. *Enzyme (Biochemistry)*: Trevor Palmer.
3. *Biochemistry*: Voet D. & Voet J.G., John Wiley & Sons.
4. *Harper's Illustrated Biochemistry*: Lange Publication.

Institute for Excellence in Higher Education (IEHE), Bhopal

M.Sc.: FINAL

Semester: III

SUBJECT: CHEMISTRY

PAPER: III

**TITLE: Spectroscopy, Diffraction Techniques and
Solid State Chemistry**

Max. Marks: 140

SYLLABUS**I. ELECTRON SPIN RESONANCE**

Basic principles, zero field splitting & kramer's degeneracy, factor affecting the 'g' value isotropic & anisotropic hyper fine coupling constant, spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications. Hyperfine coupling, spin polarization for atoms & transition metal ions, spin-orbit coupling & significance of g-tensors, application to transition metal complexes (having one unpaired electron) including biological systems & to inorganic free radicals such as PH_4F_2 & BH_3 .

II. MOSSBAUER SPECTROSCOPY

Basic principles, spectral parameters & spectrum display. Application of technique to the studies of (1) Bonding & structure of Fe^{2+} & Fe^{3+} compounds including those of intermediate spin (2) Sn^{2+} & Sn^{4+} compound-nature of M-L bond, co-ordination number, structure (3) Detection of oxidation state & inequivalent MB atoms

III. NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY

Quadrupole nuclei, quadrupole moments, electric field gradients, coupling constant, splitting, applications.

IV. (A) ELECTRON DIFFRACTION

Scattering intensity V/s scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, low energy electron diffraction & structure of surfaces.

(B) NEUTRON DIFFERACTATION

Scattering of neutrons by solid measurement techniques, elucidation of structure of magnetically ordered unit cells.

V. SOLID STATE CHEMISTRY

(A) Basic concept of X-ray diffraction & its application to determination of crystal structure & crystal defects. 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 & X-ray intensities, structure factor & its relation to intensity & electron density, phase problem, description for an X-ray structure, absolute configuration of molecules.

(B) Electronic properties and Band Theory

Metals, insulators and semiconductors, electronic structure of solids band theory, band. Structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors

Books Suggested:

1. *NMR, NOR, EPR and Moassbauer Spectroscopy in Inorganic Chemistry* – R.V. Parish, Ellis Horwood
2. *Investigation of Molecular Structure, Spectroscopic and Diffraction Methods* – B.C. Gilbert Bell and Hyman Lt. London 1984
3. *Infrared and Raman Spectra: Inorganic and Coordination Compounds* – H. Nakamoto, Wiley.
4. *An Introduction to Mossbaur Spectroscopy* Ed. – L. Jyay Pletun
5. *Basic Principle of Spectroscopy*, R, Chang, Mc Graw, Hill.
6. *Solid State Chemistry & Its Application* – A.R. West. Pennum
7. *Principle of the Solid State* – H.V. Keer & Wiley Eastern
8. *Solid State Chemistry* – N.B. Hannay.
9. *Solid State Chemistry* – D.K. Chakrabarty & New Wiley Eastern.

Institute for Excellence in Higher Education (IEHE), Bhopal

M.Sc. Final

Semester-III

SUBJECT: CHEMISTRY

PAPER: IV

TITLE: RESEARCH METHODOLOGY

Max. Marks: 100

SYLLABUS

1. Understanding the Research Process

Types of Research, Fundamental of Pure Research, Applied Research Action Research, Historical Research, Experimental Research, what is Scientific Research, Characteristics of Scientific Methodology, Qualities of Good Researcher, General rule of Academic Research. Types of research, Steps of Scientific Research

2. Problems of Identification and Preparatory Work

Exploratory field work & Identification the research area, narrowing on a specific topic, what is literature survey, role of literature survey and field work, formulating and delaminating a problem, Defining aims and objectives.

Computer Searches of literature

ASAP Alert, CA alerts, SciFinder, ChemPort, Science direct, STN international. Journal Home pages

3. Research Design

What is Research Design, preparing a Research Design, Steps in research design. Hypothesis testing in scientific research, sources of chemical information: primary, secondary & tertiary sources, indexes and abstracts in science and technology, chemical abstract, chemical titles, citation index.

4. Methodology, Method Tools and Techniques

Method of research: Survey research, case studies, qualitative and quantitative method, Ethnographic method.

Tools & Techniques: Observations, analytical instrumentation techniques.

5. Data Processing & Analysis Interpretation

Data processing, classification & categorization of data, data analysis, statistical method and statistical tools. data interpretation using computer and technology for research (chemical software).



6. Report Writing

Research ethics, avoiding plagiarism, quotations short medium and long, internet citation, foot note, writing a research paper, publication, instruction spacing, numbering heading margin, ibid etc. How to prepare ppt presentation and presentation technique?

References Books:

1. *Research Methodology* by Kothari.
2. Joseph, A. *Methodology for Research*: theological publication: banglore, 1986.
3. Gibaldi, J. Achtert, W.S., *Handbook for Writers of Research Papers*: 2nd ed.: Wiley Eastern, 1987.
4. H.M. Kanare, *Writing the Laboratory Notebook*: American Chemical Society: Washington DC, 1985.

6. Report Writing

Research ethics, avoiding plagiarism, quotations short medium and long, internet citation, foot note, writing a research paper, publication, instruction spacing, numbering heading margin, ibid etc. How to prepare ppt presentation and presentation technique?

References Books:

1. *Research Methodology* by Kothari.
2. Joseph, A. *Methodology for Research*: theological publication: banglore, 1986.
3. Gibaldi, J. Achtert, W.S., *Handbook for Writers of Research Papers*: 2nd ed.: Wiley Eastern, 1987.
4. H.M. Kanare, *Writing the Laboratory Notebook*: American Chemical Society: Washington DC, 1985.



TITLE: Analytical Chemistry

Max. Marks: 100

SYLLABUS**1) *Statistical treatment of analytical data:***

- (a) Types of Errors-True, standard & observed value, absolute and relative errors, mean and relative mean deviation. Physical significance of standard deviation, confidence limits and probability, Accuracy and precision. Significant figures, Rejection of observation- Q test, confidence interval test of significance-t test, chi-square test and F test.
- (b) Sampling and sample handling- Concept of sampling, Representative sample, storage, pre-treatment and its preparation.

2) *Methods of analysis:*

- (a) Qualitative analysis:- Basic concept of Inorganic analysis- Common ion effect, solubility product, ionic product, effect of pH and buffer in inorganic analysis.
- (b) Quantitative analysis
 - (i) Volumetric analysis – Basic concept and its types, theories of indicator, Law of equivalence, standards and its type.
 - (ii) Gravimetric analysis- Basic concept
- (c) Instrumental method of analysis
 - (i) Conductivity- TDS meter- Principle, selection of standard solutions, calibration
 - (ii) pH meter-Principle, selection of standards, calibration
 - (iii) Potentiometer- Principle, selection of standards, calibration

3) *Photometric Method of Analysis:*

- (a) Electromagnetic radiation, properties of electromagnetic radiation, electromagnetic spectrum, types of spectrum. Spectroscopy-atomic and molecular (rotational, vibrational and electronic spectra).
- (b) Spectrometer/Colorimeter- Lambert-Beer's law, Instrumentation and applications.

4) *Separation Method:*

- (a) Solvent Extraction - Introduction, principle - Distribution Law, extraction technique and its types, completeness and selectivity of extraction, factors affecting solvent extraction and analytical applications.

- (b) Chromatography -
 - (i) General principles, classification and applications.
 - (ii) A brief description of – Paper, TLC, Column chromatography.
- (c) Ion-exchange method - Ion exchangers, properties and its applications.

5) **Adsorption:**

- (a) Introduction, mechanism and its types. Adsorption of gases by solids, adsorption isotherms - Freundlich and Langmuir. Adsorption of solutes from solutions, applications.
- (b) Micelles- Surface active agents, critical micelle concentration (CMC), factors affecting the CMC of surfactant.

References:

1. Singh Mahinder, *Analytical Chemistry*, Dominant Publication.
2. Chatwal G.R, *Analytical Chromatography*, Himalaya Publication.
3. Khandpur R.S, *Handbook of Analytical Instruments*, Tata McGraw Publication.
4. Verma R.M, *Analytical Chemistry*, CBS Publication.
5. Gupta Alka, *Analytical chemistry*, Pragati Prakashan.
6. Sharma B.K, *Analytical Chemistry*, Krishna Prakashan.
7. Anjaneyulu T.B, *Analytical Chemistry*, Pharma Book Publication.

Institute for Excellence in Higher Education (IEHE), Bhopal

B.Sc. (HONOURS): PART-I

Semester: I

SUBJECT: CHEMISTRY

PAPER: HONOURS-II / SUBSIDIARY

TITLE: Inorganic Chemistry – I

Max. Marks: 100

SYLLABUS

1. Atomic Structure & Elementary Quantum Mechanics:

- (A) Quantum Numbers Shapes of *s*, *p*, *d*, *f* orbitals. Aufbau principle and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge. Dual nature of Electron, Photo Electric Effect, Compton effect, Idea of the de-Broglie matter waves, Heisenberg Uncertainty principle, Bohr's Model of Hydrogen atom (no derivation) and its defects.
- (B) Molecular orbital theory, basic ideas – criteria for forming M.O, construction M.O's by LCAO- H_2^+ ion calculation of energy levels from wave functions, concept of σ , σ^* , π , π^* & *n* orbitals and their characteristics. Hybrid orbitals – (*sp*, sp^2 , sp^3), calculation of co-efficient of A.O.'s used in these hybrid orbitals. Schrödinger wave equation, Significance of ψ and ψ^2 .

2. Periodic Properties:

Atomic and ionic radii, ionization energy, electron affinity and electro negativity definition, methods of determination, trends in periodic table and applications in predicting and explaining the chemical behaviour.

3. Chemical Bonding:

- (A) **Covalent Bond** – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence Shell Electron Pair Repulsion (VSEPR) theory to NH_3 , H_3O^+ , SF_4 , ClF_3 , ICl_2 and H_2O . MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electro negativity difference.
- (i) **Ionic Solids** – Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, Lattice defects, Semiconductors, Lattice energy and Born-Haber cycle, Solvation energy and Solubility of Ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond: free electron, valence bond and band theories.
- (ii) **Weak Interactions** – Hydrogen bonding, Vander Waals forces.

4. Oxidation and Reduction:

Use of Redox Potential Data – Analysis of Redox Cycle, Redox Stability in Water, Frost, Latimer and Pourbiac diagram, Principle involved in extraction of two elements.

5. S – Block Elements:

Comparative Study, Diagonal Relationships, Salient Feature of Hydrides, Solvation and Complexation Tendencies including their functions in bio-system, biological role of s-block elements.

6. P- Block Elements:

Comparative Study (Including Diagonal Relationship) of group 13 to 17 elements, Compounds like Hydrides, Oxides, Oxyacids and Halides of group 13 to 16, Hydrides of Boron, Diboranes and Higher Boranes, Borazines, Fullerenes, Carbides, Fluorocarbons, Silicates (structural principle), Silicones and Phosphazenes, Tetrasulphur Tetranitrides, Basic Properties of Halogens, Interhalogens and Polyhalides. Biological role of p-block elements.

7. Chemistry of Noble Gases:

Chemical Properties of Noble Gases, Chemistry of Xenon, Structure and Bonding of Xenon Compounds.

8. Acid and Bases:

Arrhenius, Bronsted and Lowry, Lux-Flood Solvent System and Lewis Concept of Acid and Bases, Pearson's Classification of Acid and Bases as Hard and Soft, Acid-Base strength and Hardness and Softness, Symbiosis, Theoretical bases of Hardness and Softness, Electronegativity and Hardness and Softness.

References:

1. Gurdeep Raj, *Inorganic Chemistry*, Krishna Publications.
2. Malik Wahid, *Inorganic Chemistry*, S. Chand Publications.
3. Lee J.D, *Concise Inorganic Chemistry*, Blackwell Publications.
4. Madan R.D, *Modern Inorganic Chemistry*, S. Chand Publications.
5. Satya Prakash, *Advanced Inorganic Chemistry*, S. Chand Publication.
6. Huheey James, *Inorganic Chemistry*, Addison Wesley publication.

Institute for Excellence in Higher Education (IEHE), Bhopal

B.Sc. (HONOURS): PART-II

Semester: III

SUBJECT: CHEMISTRY

PAPER: HONOURS-I

TITLE: Natural Products

Max. Marks: 100

SYLLABUS

- I. Alkaloids:**
Definition, classification, occurrence, extraction (outline), general properties, structure determination, degradation methods.
Structure of - Coniine, Nicotine, Piperine.
- II. Terpenes:**
Introduction, occurrence, classification, Isoprene rule, isolation, general, properties, general structure determination.
Structure of - Citral, Limonene, α -terpineol.
- III. Vitamins:**
Introduction, discovery, classification, nomenclature, metabolic, physiological functions.
Structure of vitamin-A and vitamin-C.
- IV. Pyrimidines:**
Introduction; General characters and structures. Ureides, Cyclic Ureides, Barbituric acid.
- V. Purines:**
Introduction, classification, occurrence, isolation, properties, structure and synthesis of uric acid, caffeine.
- VI. Polynuclear Aromatic Hydrocarbons:**
Introduction, occurrence, preparation, synthesis, properties and structure of naphthalene, anthracene and phenanthracene, carcinogenic activity.

References:

1. Aggarwal O.P, *Chemistry of Organic Natural Products Vol I*, Goel Publication House, Meerut.
2. Aggarwal O.P, *Chemistry of Organic Natural Products Vol II*, Goel Publication House, Meerut.
3. Chatwal Gurdeep R., *Organic Chemistry of Natural Products Vol I*, Himalaya Publication House.
4. Chatwal Gurdeep R., *Organic Chemistry of Natural Products Vol II*, Himalaya Publication House.
5. Finar I.L, *Organic Chemistry*, Pearson Publication.
6. Soni P.L, *Organic Chemistry*

Institute for Excellence in Higher Education (IEHE), Bhopal

B.Sc.(HONOURS) : PART-II

Semester: III

SUBJECT: Chemistry**PAPER: Honours-II/Subsidiary****TITLE: Physical Chemistry - I**

SYLLABUS

I. Gaseous state

Postulates of Kinetic Theory of gases, deviation from ideal behaviour, Vander Waal's equation of state.

Critical Phenomenon: PV isotherms of real gases, continuity of states, the isotherms of Vander Waal's equation, relationship between critical constants and Vander Waal's constants, the law of corresponding states, reduced equation of state.

Molecular Velocities: Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquification of gases (based on Joule-Thomson effect).

II. Liquid State

Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases.

Liquid crystal: Difference between liquid crystal, solid and liquid. Classification structure of nematic and cholestric phases. Thermography and seven segment cell.

III. Solid State

Definition of space lattice, unit cell.

Laws of crystallography: (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements in crystals.

X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's Method and Powder Method)



IV. Colloidal State

Definition of colloids, classification of colloids.

Solid in liquids (sols): Kinetic, optical and electrical, properties, stability of colloids, protective action, Hardy-Schulze Law, gold number.

Liquids in liquids (emulsions): Types of emulsions, preparation and properties, inhibition, general applications of colloids.

V. Phase Equilibrium

Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule. Phase equilibria of one component system - water, CO_2 and Sulphur systems.

Phase equilibria of two component system - Solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead.

Solid solutions - compound formulation with congruent melting point (Mg-Zn) and incongruent melting point, ($\text{NaCl-H}_2\text{O}$), ($\text{FeCl}_3\text{-H}_2\text{O}$) and ($\text{CuSO}_4\text{-H}_2\text{O}$) system. Freezing mixtures, acetone - dry ice.

Liquid-liquid mixtures: Ideal liquid mixtures, Raoult's and Henry's Law. Non ideal system - azeotropes - $\text{HCl-H}_2\text{O}$ and ethanol-water systems.

Partially miscible liquids: Phenol-water, trimethylamine-water, nicotine-water system. Lower and upper consolute temperature. Effect of impurity on consolute temperature. Nernst distribution Law - Thermodynamic derivation, applications.

VI. Thermodynamics-I

Definition of thermodynamic terms: Systems, surroundings, etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's Law - Joule-Thomson coefficient and inversion temperature. Calculation of w , q , dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

VII. Thermo Chemistry

Standard state, standard enthalpy of formation, Hess's Law of heat summation and its application. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculations from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation. Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's Principle.

VIII. Thermodynamics-II

Second Law of Thermodynamics: Need for the law, different statements of the law, Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

Concept of entropy: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, *Clausius inequality*: entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.

Reaction isotherm and reaction isochore. Clapeyron equation and Clausius-Clapeyron equation, application

Third Law of Thermodynamics: Nernst heat theorem

References:

1. Singh N.B, *Physical Chemistry*, Dominant Publication.
2. Laidler Keith J, *Chemical Kinetics*, Pearson Education publication.
3. Berry R.Stephan, *Physical Chemistry*, Oxford press publication.
4. Yadav J.B, *Physical Chemistry*, Goel publication.
5. Raj Gurdeep, *Advanced Physical Chemistry*, Krishna Prakashan.
6. Laidler J. Keith, *Physical Chemistry*, CBS Publication
7. Castellan Gilbert W, *Physical Chemistry*, Narosa publication

Institute for Excellence in Higher Education (IEHE), Bhopal

B.Sc. (HONOURS): PART-III

Semester: V

SUBJECT: CHEMISTRY

PAPER: HONOURS-I

TITLE: Industrial Chemistry

Max. Marks: 100

SYLLABUS

1. *Metallurgy:*

Introduction, Characteristics and Physical properties of metals, Slags and Fluxes, Classifications of ores, Furnaces and dressing of ores.

Metallurgy of Cast Iron from Haematite ore, Copper from Copper Pyrite and Aluminium from Bauxite.

Alloys:

Introduction, Purpose of Alloying, Types of Alloys, Ferrous Alloys – Steel (Properties and Heat treatment of Steel), Non Ferrous Alloys – Composition, Characteristics and uses of the alloys of copper and aluminum.

2. *Sugar Industry:*

Introduction, manufacture of cane sugar, extraction and purification of juice, defection, sulphitation and carbonation, concentration or evaporation, crystallization recovery of sugar from molasses, Manufacture of sucrose from beet root and testing of sugar.

3. *Fats, Oils and detergents:*

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, halogenation of unsaturated oils, saponification value, iodine value, acid value, soaps and synthetic detergents.

4. *Paper and Pulp Technology:*

Introduction, Types of pulping, manufacturing of pulp, sulphate or kraft pulp, soda pulp, sulphite pulp, rag pulp, beating, refining, filling, sizing and coloring. Peroxide bleaching and its chemistry, Importance of bleaching. Manufacture of paper, calendaring and uses. Paper industry in India.

5. *Cement Technology:*

Classification of cements (Hydraulic and Non-hydraulic), Portland cement production: (1) Quarrying and Crushing (2) Raw material handling and Storage (3) Raw material blending & homogenization (4) Clinker production, cooling and grinding. Hydration chemistry of Portland cement, Setting of cement & factors affecting it.

6. Lubricants:

Introduction, Mechanism of Lubrication, Classification of Lubricants – Solid, Liquid, Semi-Solid Lubricants: Grease, Properties of Lubricating Oils and Greases, Synthetic Lubricants, Lubricating Emulsions, Cutting Fluids

7. Fuels:

Introduction and Classification of Fuels, Characteristics of a good Fuel

Calorific Value: Definition, Units, Gross and Net Calorific Value, Determination of Calorific Value – Bomb Calorimeter [Construction, Working and Calculations (use of Dulong's Formula)].

Coal: Origin, Classification of Coal by Rank, Selection of Coal, Analysis of Coal –Proximate and Ultimate Analysis, Carbonization of Coal, Pulverized Coal, Metallurgical Coke – Requisites of Metallurgical Coke and Manufacture of Metallurgical Coke.

Petroleum: Origin, Classification, Cracking – Thermal and Catalytic Cracking, Synthesis of Synthetic Petrol – By Polymerization and By Fischer-Tropes Method, Refining of Gasoline, Reforming and Knocking.

Gaseous Fuels: Classification, water gas, producer gas, LPG and CNG.

Non-Conventional Sources of Energy: Biomass and Biogas.

References:

1. J. A. Kent: Riegel's, *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
2. S. C. Bhatia: *Chemical Process Industries*, Vol. I & II, CBS Publishers, New Delhi.
3. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
4. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
5. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut.
6. E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
7. B. K. Sharma: *Industrial Chemistry*, Goel Publishing House, Meerut.



Institute for Excellence in Higher Education (IEHE), Bhopal

B.Sc. (HONOURS): PART-III

Semester: V

SUBJECT: CHEMISTRY

PAPER: HONOURS-II / SUBSIDIARY

TITLE: Organic Chemistry

Max. Marks: 100

SYLLABUS

1. Organic Polymer:

Definition, natural polymer, plastic elastomers, fibers homopolymers, co-polymers, Thermoplastic, Thermoset, Recycled plastics, PET, HDPE, PVC, GDPE, PS.

2. Carboxylic Acid:

Monocarboxylic Acid: Nomenclature, Structure and acidic nature, comparison of carbonyl group's nature in carboxylic acids, aldehydes and ketones. Preparation and Properties of Fatty acids.

Dicarboxylic Acid: Preparation and Properties of – Oxalic acid, Malonic acid and Succinic acid.

3 Carboxylic Acid Derivatives:

Nomenclature, Preparation and Properties of Acid Chlorides, Amides, Acid Anhydrides and Esters, Mechanism of Esterification.

4 Organic Synthesis via Enolates:

Acidity of α -hydrogens, alkylation of malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the claisen condensation, keto-enol tautomerism of ethyl acetoacetate.

Alkylation of 1,3 dithianes, alkylation acylation of enamines

5 Organ metallic compounds: Organomagnesium compounds; Grignard reagents- Formation, structure and chemical reactions

Organozinc compounds: Formation and chemical reactions.

Organolithium compounds: Formation and chemical reactions.

6 Organosulphur compounds:

Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

7 Organic Compounds of Nitrogen:

Nitroalkanes and Nitroarenes: Preparation and Chemical properties. Mechanism of nucleophilic substitution in Nitroarenes and their reduction in acidic, neutral and alkaline media.

Amines: Aliphatic and Aromatic amines- their nomenclature, preparation and properties. Separation of primary, secondary and tertiary aliphatic amines Structural features affecting the basicity in aliphatic and aromatic amines. Electrophilic aromatic substitution in aryl amines.

Diazonium Salts: Preparation and Properties.

8 Heterocyclic Compounds:

Aromatic behaviour of 5 and 6 membered heterocyclics. preparations and chemical properties of Pyrrole, Furan, Thiophene and Pyridine, mechanism of electrophilic substitution and their reactivity at α and β carbon atoms. Mechanism of nucleophilic substitution reactions in Pyridine. Comparison of basicity of Pyridine, Piperidine and Pyrrole.

Preparation and properties of Indole, Quinoline and Isoquinoline. mechanism of substitution reactions.

9 Carbohydrates:

Classification of Carbohydrates, Monosaccharides: Nomenclature properties of aldoses and ketoses. Interconversion of glucose, mannose and fructose, chain lengthening and chain shortening. Configuration of monosaccharides. Erythro and Threo diastereomers. Formation of glycosides, ethers and esters. Structure of D (+) Glucose, D(-) Fructose, (open and cyclic), determination of ring size. Mechanism of Mutarotation.

An introduction to Disaccharides (Maltose, Sucrose and Lactose) their conformation and properties, Polysaccharides (Starch and Cellulose) Properties.

10 Amino Acids, Peptides, Proteins and Nucleic Acids:

Amino Acids: Classification, structure and stereochemistry of Amino acids. Acid-base behaviour, Isoelectric point and Electrophoresis. Preparation and properties of α Amino acids.

Peptides: synthesis, properties and structure. Sequence determination of amino acid by end group analysis.

Proteins: Classification, nomenclature, properties and tests. Denaturation and Renaturation. Levels of protein structure.

11 Electromagnetic Spectrum : Absorption Spectrum:

Ultraviolet Spectroscopy: Beer Lambert's Law, Molar Absorptivity, Types of electronic transition, Effect of conjugation. Concept of Auxochrome and Chromophore, Bathochromic, Hypsochromic, Hyperchromic and Hypochromic Shift. Colour and constitution. UV spectra of conjugated Enes and Enones. Analysis of UV Spectra.

InfraRed Spectroscopy: Molecular vibration, Hook's law, Selection rules, Intensity and position of IR bands, measurement of IR spectra, Fingerprint region, characteristic absorption of various functional groups. Interpretation of IR spectra of simple organic compounds.

12 Nuclear Magnetic Resonance Spectroscopy:

Introduction, shielding and deshielding, Chemical shift and Molecular structure, spin-spin splitting and coupling constants, Axes of signals, Interpretation of PMR Spectra of Simple Organic molecules like ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, Toulene and acetophenone. Problem pertaining to structure elucidation of Simple Organic compounds using UV, IR and PMR Spectroscopic techniques.

References:

1. March Jerry, *Advanced Organic Chemistry*, Weley Publication.
2. Kalsi P.S, *Spectroscopy of Organic Compound*, New Age Publication.
3. Sharma Y.R, *Elementary Organic Chemistry*, S. Chand Publication.
4. Ernest L. Elie's, *Stereochemistry of Organic Compound*, Weley Publication.
5. Finar I.L, *Organic Chemistry*, Pearson Publication.
6. Sharma B.k, *Spectroscopy*, Krishna Prakashan.
7. Bhatnagar M.S, *Polymer Chemistry*, S. Chand Publication.



Institute for Excellence in Higher Education (IEHE), Bhopal**B.Sc. (HONOURS): PART-I****Semester: II****SUBJECT: CHEMISTRY****PAPER: HONOURS-I****TITLE: Environmental Chemistry****Maximum Marks: 100****SYLLABUS****1. Atmospheric Chemistry:**

- (a) Evolution of Atmosphere, Major region of Atmosphere, composition of Atmosphere, Temperature inversion, Meteorology and Human activities, Surface temperature of Earth, Earth's Heat balances.
- (b) Photochemistry: Primary photochemical process, Radicals in Atmosphere ($\text{OH}^\cdot$) and ($\text{HO}_2^\cdot$). Ions in mesosphere and lower Thermosphere, Reactions of atmospheric Nitrogen, O_2 , CO_2 and H_2O .

2. Air Pollution:

Classification and control of air pollutants:

Inorganic air pollutants: Oxides of C, N, S, Ozone, Carbonyl Sulphides and Carbon disulphide. Fluorine and its compounds

Organic Air pollutants: Hydrocarbons, Alkyl Aryl halides, Aldehyde and Ketones. Acid Rain, photochemical Smog, Depletion of ozone layer, Green House Effect and its consequences

3. Water Pollution:

Classification of water pollutants:

Hardness and Alkalinity, DO, BOD and COD

Control of water pollution: Water softening, Advanced Techniques of Water treatment: Using liquid-liquid separation, liquid-solid separation, use of coagulants and High intensity aeration process. Removal of Metallic ions, Waste water treatment methods: Nitrogen removal, phosphorus removal, sludge treatment. Sewage treatment: Primary, secondary, tertiary. Water Reuse and Recycle

4. Soil Pollution:

Soil type, Trace metals, Organic matter in soil and micro nutrients in soil, pollution of soil, Agricultural pollution

5. Biochemical Effect of Toxic Metals on Man:

Enzymes inhibited by Toxic metals, Effect of Mercury, Lead, Arsenic, Cadmium and Cobalt.

6. Thermal Pollution: Sources and Effect of Thermal pollution and its control.

7. **Noise Pollution:** Sources and Effect of Noise pollution and its control.
8. **Radioactive Pollution:** Types of radiations, Radioactive Decay process, Decay law, Radiation detectors, Harmful effect of radiation, Radiation safety standards, Waste disposal problem, Nuclear reactor Accidents.
9. **Basic Principles of Green Chemistry:** Prevention of waste or By-products, Maximum incorporation of the reactant into the final product, 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, Product Designed should be biodegradable, Designing of manufacturing plants, Strengthening of analytical techniques.

Reference Books:

1. Chatwal, G.R., *Environmental Studies*, Himalaya Publication
2. Sharma, B.K., *Environment Chemistry*, Krishna Prakashan
3. Dara, S.S., *Environment Chemistry and Pollution Control*, S.Chand Publication
4. Sawyer, Clair, *Chemistry for Environmental Engineering*, Tata McGrawPublication
5. Mishra, D.D., *Environmental Chemistry*, S.Chand Publication
6. Banerjee, Samir, *Environmental Chemistry*, P.H.I.Publication
7. Jadhav, H.V., *Environmental Pollution*, Himalaya Publication
8. Sindhu, P.S., *Environmental Chemistry*, New Age Publication

Institute for Excellence in Higher Education (IEHE), Bhopal

B.Sc. (HONOURS): PART-I

Semester: II

SUBJECT: CHEMISTRY

PAPER: HONOURS II/SUBSIDIARY

TITLE: Organic Chemistry-I

Maximum Marks: 100

SYLLABUS

1. Structure and Bonding:

Characteristics of carbon, concept of hybridization(sp^3, sp^2, sp) and their molecular shapes, Vander Waals interactions, Inclusion compounds, Charge transfer complexes, polar effects, hyper conjugation, Resonance, Hydrogen bonding, its types and effect on physical properties.

2. Mechanism of Organic Reactions:

Bond cleavage, types of reagents, types of organic reactions, energy considerations, thermodynamic and kinetic control. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereo chemical studies.)

Reactive intermediates:

Carbonium ions, Carbanions, Free radicals, Carbenes, Arynes, and Nitrenes their structure and stability.

3. Stereochemistry of Organic Compounds:

Concept of Isomerism, types of isomerism.

Optical Isomerism – Elements of Symmetry, Molecular Chirality, Enantiomers, Stereogenic Centres, Diastereomers, Threo and Erythro stereoisomers, meso Compounds, Resolution of Enantiomers, Inversion, Retention and Racemization. Relative and Absolute Configuration, Sequence Rules, D- and L- and R- and S- Systems of Nomenclature.

Geometrical Isomerism – Determination of Configuration of Geometrical Isomers. E and Z System of Nomenclature, Geometrical Isomerism in Oximes and Alicyclic Compounds.

Conformational Isomerism – Conformational Analysis of Ethane and n-butane, Conformation of Cyclohexane, Axial and Equatorial Bonds, Conformation of Mono-substituted Cyclohexane Derivatives. Newman Projection and Sawhorse Difference between configuration and conformation.

4. Alkanes and Cycloalkanes:

IUPAC Nomenclature and Isomerism of Alkanes, Physical properties and chemical properties of alkanes, Mechanism of free radical halogenation of methane, energy consideration, orientation, reactivity and selectivity.

Cycloalkanes- Nomenclature and isomerism, methods of formation, chemical reactions, stability of Cycloalkanes, Baeyer's strain theory and its limitations, theory of strainless rings, conformation of cyclohexane.

5. Alkenes and Cycloalkenes:

Nomenclature and Isomerism of alkenes & cycloalkenes, methods of formation, physical properties and relative stabilities. Chemical reactions - mechanisms involved in hydrogenation, electrophilic addition and Markownikoff's rule, free radical and Antimarkownikoff's rule, hydroboration - oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO_4 , OsO_4 . Polymerization of alkenes by cation, anion and free radical mechanisms. Substitution at the allylic and vinylic positions of alkenes.

Dienes and Alkynes: Nomenclature, classification, properties and structure of dienes. Butadiene, stability and properties, addition, polymerization, Diel's Alder reaction.

Nomenclature, structure, bonding and acidity in alkynes, methods of formation & their chemical reactions. Mechanism of electrophilic and nucleophilic addition reactions, oxidation, reduction and polymerization.

6. Arenes and Aromaticity:

Nomenclature of benzenederivatives. Thearyl-group. Aromatic nucleus and side chain,

Structure of benzene-Molecular formula Evidences in favor of Kekule structure, stability and Carbon-Carbon bond length in benzene, resonance structure and Molecular Orbital structure, resonance energy.

Aromaticity-Huckel's rule, Aromatic sextet, Aromatic behavior of non-benzenoid compounds.

Aromatic electrophilic substitution- general pattern of the mechanism, role of σ and π complexes, mechanism of nitration, halogenations, sulphonation, Friedel-craft reaction. Energy profile diagrams. Activating and deactivating groups, Directing Influence of substituents, Orientation and ortho/para ratio.

Methods of formation and chemical reactions of alkyl benzenes and biphenyl.

7. Alkyl and Aryl halides:

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, mechanism of nucleophilic substitution reactions of alkyl halides, SN^2 and SN^1 mechanism with energy profile diagrams, Saytzeff and Hofmann elimination.

Polyhalogen compounds: chloroform, carbon tetra chloride methods formation and chemical properties.

Aryl halides: Methods of formation, chemical properties - nuclear and side chain reactions, the addition - elimination and the elimination - addition mechanism of substitution reactions.

Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.



8. Alcohols

Classification and nomenclature.

Monohydric alcohols - Methods of formation effect of hydrogen bonding on physical properties, acidic nature and chemical properties.

Dihydric alcohols - Methods of formation, chemical reactions of glycols, oxidative cleavage, pinacol-pinacolone rearrangement.

Trihydric alcohols - glycerol-synthesis, physical and chemical properties.

9. Phenols

Nomenclature, preparation of phenols, physical properties and acidic character. Comparison of acidic strengths of alcohols and phenols. Electrophilic substitution and other properties with mechanism.

10. Aldehyde and Ketones

Nomenclature, structure and reactivity of carbonyl group, synthesis of aldehyde and Ketone, physical and chemical properties, mechanism of nucleophilic addition to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation. Application of acetals as protecting group of carbonyl group. Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Cannizzaro-reaction. Halogenation and enolisation of aldehyde and ketones. Reductions-Meerwein-Ponndorf Verley (MPV) reduction, Clemmensen's, Wolf Kishner reductions, reductions with metal hydride (LiAlH_4 and NaBH_4). Oxidation of aldehydes, Baeyer-villiger oxidation of ketones.

References :

1. Finar, I. L., *Organic Chemistry, Vol-I, edition 6th*, B S/E L with Longman publication
2. Mukherji, S.M., *Reaction Mechanism in Organic Chemistry*, Macmillan Publication
3. Morrison, R.T., *Organic Chemistry*, Prentice Hall Publication
4. Jerry March, *Advanced Organic Chemistry*, Wiley Publication
5. Robert Thornton, *Organic Chemistry*, Pearson Publication
6. Sykes Peter, *A Guidebook to Mechanism in Organic Chemistry*, Pearson Publication
7. Madan, R.L., *Organic Reaction Conversion*, S. Chand Publication

*Institute for Excellence in Higher Education (IEHE), Bhopal***PART-II**Semester: **IV****CHEMISTRY****PAPER: HONOURS - I****TITLE: Mathematical & Computer Applications in Chemistry**Maximum Marks: **100** (50 marks for each section A and B)**SYLLABUS****Section-A: Syllabus for mathematical application in Chemistry****Trigonometry**Trigonometric functions, Graphical presentation of Trigonometric function for $\sin\theta$, $\cos\theta$ & $\tan\theta$.**Algebra**

1. *Set theory:* Set, subset, power set, Operation on sets: Union, Intersection, Disjoint, Differences and compliments of sets, Algebra of sets (laws of sets).
2. *Euler Venn Diagrams:* Relations, Domain and Range of a relation, various type of relations.
3. *Complex Numbers:* Imaginary numbers, Complex numbers, Properties of complex numbers.
4. *Sequences & Series:* Arithmetic Progression, Geometric Progression, Exponential series, Logarithm series.
5. *Binomial Theorem:* Theorem and its simple applications.
6. *Quadratic Equations:* Roots of an equation, Number of roots, Equation reducible to quadratic equations, Symmetric function.

Determinants and Matrices

1. *Determinants* of order two and three, Minors, Cofactors, Expansion of determinants, Properties of determinants, Value of a determinant.
2. *Matrix:* Definition, Operations on matrices, Addition, Subtraction and multiplication of matrices, Linear combination of matrices, Solution of linear equations.

Three Dimensional Geometry

Coordinate axes, Distance between two points, Cartesian Coordinates, Angle between two lines.

Vector Algebra

Definitions, Addition of vectors, Difference of vectors, Multiplication of vectors – dot product and vector products, Orthogonal systems of unit vectors.

Function, Limits & ContinuityFunction, constant, Variable, Domain of variable, Binary operations, Graph of a real function, Limits, evaluation of limits, Some important limits (important limit value only) meaning of the symbol $\lim_{x \rightarrow \infty} f(x) = L$. Properties of continuous functions.

Differentiation (Differential calculus)

Meaning, Differentiation of standard form, Differential of sum, Difference, Product and quotient, Differential coefficient of a function of functions. Second derivatives.

Integral Calculus

Infinite integration by substitution (simple cases), Definite integrals.

Differential Equations

Linear equation, Formation of differential equation, Solution of a differential equation (without variable).

Section-B: Syllabus for Computer Application

In computer application, the students have to learn 'C' language and its application in Chemistry. The topics of chemistry should be within the syllabus of chemistry as prescribed by UGC for B.Sc. classes.

'C' Language will cover the following topics:

1. **Programming Language:** Brief description of machine language and assembly languages. Language translators. Algorithm and flow charts. An over view of 'C' programming
2. **Data Type, Constants & Variable:** Character set, 'C' tokens, Keywords and Identifiers. Constant & variable, Data type, Declaration of variable, assigning values to variables, symbolic constants.
3. **Operators & Expressions:** Arithmetic, Relational, Logical, Assignment, Increment and decrement, Conditional, Bit wise & special Operators. Arithmetic expressions, Evaluation of expression. Precedence of arithmetic operators, Mathematical functions.
4. **Input/Output Operations:** Reading & writing character, Formatted input and output.
5. **Control Statements:** If, If Else, Nesting of If ... Else statement, The Else ... If ladder, The switch statement, the ?: operator and GOTO statement.
6. **Looping:** While, Do-While, for loops, Jumps in loops the break, Continue and Exit statement.
7. **Arrays:** One dimensional & Two dimensional arrays.
8. **Character Strings:** Declaring & initializing string variables. Reading & writing of strings.
9. **User Defined Functions:** The form of 'C' functions, Return values and their types, calling a function. categories of functions: (i) No argument – no return value (ii) Argument but no return values (iii) Argument with return values. Function with Arrays, The scope and lifetime of variables in function (Local and global variables).
10. **File Management:** Opening, Reading and closing a file in 'C' Input /Output operation on files.

Reference Books:

1. Singh, Bhupendra, *Mathematics for Chemist*, Pragati Prakashan
2. Kumari Ramesh, *Computers and their Application to Chemistry*, Narosa Publication
3. Aggarwal, Naresh, *Computer in Chemistry*, Sonali Publication
4. Rao, Sambasiva R., *Computer Application in Chemistry*, Himalaya Publication
5. Sigh, S.K., *Mathematics and Computer for Chemist*, S. Chand Publication
6. E. Balagurusami, *ANSI C*, S. Chand Publication
7. Yashvant Kanitkar, *Let Us 'C'*, BPB Publication

Inorganic Chemistry-II

Maximum Marks: 100

SYLLABUS**1. Chemistry of First Transition Series:**

Characteristic Properties of d-Block Elements, Properties of Elements of First Transition Series, their Binary Compounds and Complexes illustrating Relative Stability of their Oxidation States, Coordination Number and Geometry.

2. Chemistry of Second and Third Transition Series:

General Characteristics, Comparative Treatment with their 3d analogues in respect of Ionic Radii, Oxidation States, Magnetic behavior and Spectral Properties and Stereo-chemistry.

3. Coordination Compounds:

Werner's Coordination Theory and its Experimental Verification, Effective Atomic Number Concept, Chelates, Nomenclature of Coordination Compounds, Isomerism in Coordination Compounds, VBT of Transition Metal Complexes. Biological Role of Coordination Compounds-Haemoglobin and Myoglobin.

4. Metal Ligand Bonding in Transition Metal Complexes:

Limitation of VBT and Elementary idea of CFT, Crystal Field Splitting in Octahedral, Tetrahedral and Square Planar Complexes, Factors Affecting Crystal Field Parameters.

5. Magnetic Properties of Transition Metal Complexes:

Types of Magnetic Behaviour, Methods of Determining magnetic Susceptibility, Spin only Formula, L-S Coupling, Correlation of μ_s and μ_{exp} values, Orbital Contribution to Magnetic Moments, Application of Magnetic Moment Data for 3d Metal Complexes.

6. Electronic Spectra of Transition Metal Complexes:

Types of Electronic Transitions, Selection Rules for d-d transition, Spectroscopic Ground States, Spectro-chemical Series, Orgel Energy Level Diagram for d^1 to d^9 states. Discussion of Electronic Spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ Complex Ion.

7. Thermodynamics and Kinetic Aspects of Metal Complexes:

A Brief Outline of Thermodynamic Stability of Metal Complexes and Factors affecting stability, Substitution Reaction of Square Planar Complexes.

8. Chemistry of Lanthanide Elements:

Electronic Structure, Oxidation State and Ionic Radii and Lanthanide contraction. Complex Formation, Occurrence and Isolation of Lanthanides.

9. Chemistry of Actinides:

General Features and Chemistry of Actinides, Chemistry of Separation of Np, Pu, Am from U. Similarities between later Actinides and later Lanthanides.

10. Organometallic Chemistry:

A Brief Account of Metal-ethylene Complexes and Homogeneous Hydrogenation, Mononuclear Carbonyls and Nature of Bonding in Metal Carbonyls.

Reference Books:

1. Gurdeep Raj, *Inorganic Chemistry*, Krishna Publication
2. Malik Waheed, *Inorganic Chemistry*, S. Chand Publication
3. Madan R.D., *Modern Inorganic Chemistry*, S. Chand Publication
4. Satya Prakash, *Advanced Inorganic Chemistry*, S. Chand Publication
5. Lee J.D., *Concise Inorganic Chemistry*, Blackwell Publication
6. Huheey James, *Inorganic Chemistry*, Addison Wesley Publication
7. Cotton & Wilkenson, *Advanced Inorganic Chemistry*, Wiley John Publication
8. Malik Waheed, *Selected Topic in Inorganic Chemistry*, S. Chand Publication.



Institute for Excellence in Higher Education (IEHE), Bhopal

PART-III

Semester: VI

CHEMISTRY

PAPER: HONOURS-I

BIOCHEMISTRY

Maximum Marks: 100

SYLLABUS

1. Introduction to Biochemistry & Bio-Physical Chemistry:

- (a) water metabolism-Dehydration & its types, Biochemical Functions of Inorganic Ions: Role of Ca^{2+} , K^+ , Na^+ , Mg^{2+} , Fe^{2+} in living system & their requirements Fe storage & transport proteins-Ferritin, transferrin & hemosiderin, Oxygen transport, Protein, Fe-S proteins.
- (b) **pH scale, buffer** - General introduction of Acid & Base. Buffer-Definition, composition, Henderson equation, Role of different biological buffer system like- Phosphate buffer, Bicarbonate buffer, Protein /Amino acid buffer, Haemoglobin buffer system.

2. (a) **Biological oxidation** - Definition, Types of biological oxidation Reduction oxidation by direct action of oxygen, oxidation by loss of hydrogen.

- (b) Mitochondrial electron transport chain, inhibitors of ETC.

- (c) **Oxidative phosphorylation** - Definition, Theories, Inhibitors of Oxidative-phosphorylation, Un-couplers.

3. (a) **Bioenergetics** - Coupled reaction, law of thermodynamics, Free energy, Relationship between Standard Free energy change & Equilibrium constant. General introduction of high energy compounds.

- (b) **Introduction to ATP** - Structure, ATP as universal currency of free energy in biological systems with example-in muscle contraction, Free energy of ATP Hydrolysis.

4. Nucleic Acid & Enzymes:

- (a) **Nucleic Acid** - Introduction, constituents (sugars and bases), nucleosides and nucleotides. **Double helical structure of DNA.**

- (b) **Enzyme** - Definition, Classification, Nomenclature, Coenzyme, Cofactors, Properties of enzyme, factors affecting enzyme activity, Active site, Mechanism of enzyme action- Lock & Key theory, Koshland theory, strain theory. Enzyme Kinetics - Michaelis-Menton equation, L.B Plot. Medical importance of enzyme.

5. **Metabolism / Clinical Application:**

- (a) **Carbohydrate** - Glycolysis, TCA, Glycogenesis, Glycogenolysis, HMP shunt, Gluconeogenesis.
Bioenergetics, clinical application. Inborn error of carbohydrate metabolism.
- (b) **Lipid** - β **Oxidation** of Fatty acid, TG Hydrolysis, Ketone bodies metabolism.
Bioenergetics, clinical application. Inborn error of lipid metabolism.
- (c) **Amino-acid/Protein** - Transamination, Decarboxylation, Deamination, Fate of ammonium, urea cycle. Clinical application-Inborn error of Amino/Protein metabolism.
- (d) Clinical Applications of biochemistry.

Reference Books:

1. Jain, J.L. *Fundamental of Biochemistry*, S. Chand Publication
2. Lehninger, Albert T., *Biochemistry*, Kalyani Publication
3. William, H. Elliott, *Biochemistry & Molecular biology*, Oxford Publication
4. Phillip, W. Kuchel, *Theory & Problems of Biochemistry*, Tata McGraw Publication, Delhi
5. Mathews, Christopher K., *Biochemistry*, Pearson Education Publication
6. Palmer Trevor, *Enzymes*, Affiliated East Publication
7. Wilsom, Keith, *Principles & Techniques in Biochemistry*, Cambridge Publication
8. Powar, C.B, *Biochemistry*, Himalaya Publication
9. Murray, Robert K., *Harper's Illustrated Biochemistry*, McGraw Hill Publication
10. Rastogi, S.C, *Biochemistry*, Tata McGraw Publication
11. Hames BD; Hooper NM, *Instant Notes Biochemistry*, Viva Books Private Ltd, New Delhi

Institute for Excellence in Higher Education (IEHE), Bhopal

PART-III

Semester: VI

Chemistry

PAPER: Honours-II/Subsidiary

Title: Physical Chemistry – II

Maximum Marks: 100

SYLLABUS

I. Chemical Kinetics and Catalysis:

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, Mathematical characteristics of simple chemical reactions – Zero order, first order, second order, pseudo order, half-life and mean life. Determination of the order of reaction-differential method, method of integration, method of half-life period and isolation method.

Radioactive decay as a first order phenomena. Experimental methods of chemical kinetics, conductometric, potentiometric, optical methods, polarimetry and spectrophotometer.

Theories of chemical kinetics: Effect of temperatures on rate of reaction, Arrhenius equation, concept of activation energy, simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and Thermodynamic aspects. Catalysis, characteristics of catalyzed reactions, classification of catalysts miscellaneous examples.

II. Electro Chemistry – I

Electrical transport - conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

Debye Huckel - Onsager's equation for strong electrolytes (elementary treatments only). Transport number, Its definition and determination by Hittorf method and moving boundary method.

Application of conductivity measurement, determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.



III. Electrochemistry-II:

Types of reversible electrodes - gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode – reference electrodes - Standard electrode potential, Sign conventions, electrochemical series and its significance. Electrolyte and Galvanic cells: reversible and irreversible cells, conventional representation of electrochemical cells.

EMF of a cell and its measurements. Computation of cell EMF. Calculation of Thermodynamic quantities of cell reactions (ΔG , ΔH and K), polarization, over potential and hydrogen over voltage.

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and pK_a . Determination of pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods.

Buffers: Mechanism of buffer action, Henderson-Hassel batch equation. Hydrolysis of salts.

Corrosion: Types, theories and methods of combating it.

IV. Physical Properties and Molecular Structure:

Optical activity, polarization – (ClausiusMossotti equation), Orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment – temperature method and refractivity methods, dipole moment and structure of molecules, magnetic properties, Paramagnetism, diamagnetism and ferromagnetism.

V. Photochemistry:

Introduction of radiation with matter, difference between thermal and photochemical process. Laws of photochemistry: Grothus-Drapper Law, Stark – Einstein Law, Jablonski diagram depicting various process occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative process (internal conversion, intersystem crossing) quantum yield, photosensitized reaction, energy transfer process (Simple examples).

VI. Spectroscopy:

Introduction, electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born Oppenheimer approximation, degrees of freedom.

