

GOVT. E. RAGHAVENDRA RAO (AUTONOMOUS) P. G. SCIENCE
COLLEGE, BILASPUR (C. G.)

SYLLABUS

M. Sc. CHEMISTRY

2023-24

SEMESTER - I

DEPARTMENT OF CHEMISTRY

M.Sc. I- SEMESTER, CHEMISTRY

GENERAL SCHEME

1. There shall be four theory papers; each of 100 marks, out of which 20 marks will be for internal assessment.
2. There will be one practical/laboratory course + Project Work of 200 marks.
3. The effective teaching hours for each theory paper are 70 hours and for practical 140 hours.
4. Practical examination will be conducted at the end of semester.

THEORY PAPERS

PAPER	TITLE	TEACHING DURATION
I	Inorganic Chemistry	70 hrs
II	Organic Chemistry	70 hrs
III	Physical Chemistry	70 hrs
IV	Analytical Chemistry & Maths/Biology for Chemists	70 hrs

PRACTICAL / LABORATORY COURSE

Laboratory course – I Special practical, 200 marks, duration 140 hrs and examination of 12 hours (separated over two days)

MARKS DISTRIBUTION

INTERNAL ASSESSMENT: 20 marks (Test-10 & Seminar-10) of each theory paper

THEORY :-

Paper	External	Internal	Passing Marks
I, II, III & IV	80	20	36

	Question Pattern		Total Marks
Section-A	Objective Question- 10	1x10	10
	Short Answer Questions-05	2x5	10
Section -B	Descriptive Question- 08 (50% Internal Choice)	15x4	60
		Grand Total	80

PRACTICAL :

I Physical Chemistry	100	36
II Analytical chemistry	100	36

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M.Sc. I-SEMESTER, CHEMISTRY (2023-24)

PAPER - I

INORGANIC CHEMISTRY

Max. Marks : 80

1. Metal Ligand Equilibria in Solution:

Step-wise and overall formation constants and their interaction, trend in step-wise constants, 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 pH- metry and spectrophotometry.

2. Reaction Mechanism of Transition Metal Complexes:

Energy profile of reaction, reactivity of metal complexes, 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 favour of conjugate mechanism, anation reactions, reaction without metal ligand bond cleavage, Substitution reaction in square planar complexes. the trans affect, mechanism of the substitution reaction. Redox reactions, electron transfer reactions. Mechanism of one electron transfer reactions, outer sphere type reaction, cross reactions and Marcus- Hush Theory, inner sphere type reactions.

3. Electronic Spectra and Magnetic properties of Transition Metal Complexes :

Spectroscopic ground states, correlation, Orgel and Tanabe- Sugano diagrams for transition metal complexes ($d^1 - d^9$ state), calculation of Dq , B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereo chemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

4. Symmetry and Group Theory in Chemistry:

Symmetry elements and symmetry operation, definition of group subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Point symmetry group, Schonflies symbols, representations of group by matrices (representation for C_n , C_{nv} , C_{nh} , D_{nh} etc groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use, spectroscopy.

Books suggested:

1. Advance d Inorganic Chemistry; F.A. Cotton and Wilkinson :John Wiley
2. Inorganic Chemistry; J. F. Huhey, Harpes & Raw.
3. Chemistry of the Elements; N.N. Greenwood and A. Ernshow, Pergmon.
4. Inorganic Electronic Spectroscopy; A.B.P. Lever, Elsevier.
5. Megnetochemistry; Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds. G. Wilkinson, R. D. Gillars and J. A. McCleverty, Pergamon.
7. Chemical Application of Group Theory; F. A. Cotton.

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PAPER – II

ORGANIC CHEMISTRY (THEORETICAL ORGANIC CHEMISTRY)

Max.M : 80

1. Nature of Bonding in Organic Molecules:

Delocalized chemical bonding- conjugation, cross conjugation, resonance, hyper conjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternate and non alternate hydrocarbons. Huckel's rule, energy level of π - molecular orbitals, annulenes, antiaromaticity, homo-aromaticity.

2. Stereochemistry:

Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers. Methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces. Stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of the compound containing Nitrogen, Sulphur and phosphorous.

3. Structure and Reactivity :

Types of reactions, types of mechanisms. Thermodynamic and Kinetic requirements, Kinetic and Thermodynamic control, Hammond's postulate, Curtin – Hammet Principle. Potential energy diagram, transition state and intermediates, methods of determining mechanisms. Isotope effects. Hard and soft acids and bases, Effect of structure on reactivity, resonance and field effects, steric effect, the Hammett equation and linear free energy relationship, substituent and reaction constant.

4. Molecular Rearrangement Reaction:

General mechanistic approach to molecular rearrangement reactions, carbocation rearrangement. Migratory aptitude and Memory effects. Brief study of rearrangement reactions: Pinacol Pinacolone, Favorskii, Baeyer – Villiger oxidation, Stork enamine reaction, Shapiro reaction, Michael addition, Sommelet rearrangement, Wittig's rearrangement, Grovenstein – Zimmerman rearrangement.

5. Pericyclic Reaction:

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3 – butadiene, 1,3,5 – hexatriene and allyl system. Classification of pericyclic reaction. Woodward Haffmann correlation diagram, FMO AND PMO approach. Electrocyclic reactions-conrotatory and disrotatory motion, $4n, 4n+2$ and allyl system. Cycloadditions antaredical and suprafacial addition, $4n, 4n+2$ and systems, $2+2$ addition of ketenes, 1,3 dipolar cycloaddition and cheletropic reactions, Sigmatropic rearrangements –suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3 and 5,5- sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements. Fluxional tautomerism, Ene reaction.

Books suggested:

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1. Advanced Organic Chemistry "Reaction 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, Longman.
4. 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. Principle of Organic Synthesis; R. O. C. Norman and J. M. Coxon, Blackie Academic and Professional.
8. Pericyclic REACTION; S. M. Mukherji, Macmillan India.
9. Reaction Mechanism in Organic Chemistry; S. M. Mukharji and S. P. Singh, Macmillan.
10. Stereochemistry of Organic Compounds; D. Nasipuri, New age international.
11. Stereochemistry of Organic Compounds; P. S. Kalsi, New age international.

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PAPER – III

PHYSICAL CHEMISTRY (GENERAL PHYSICAL CHEMISTRY)

Max. M : 80

QUANTUM CHEMISTRY:

A. Introduction in Exact Quantum Mechanical Result:

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

B. Approximate methods:

The various theorem, linear variation principle. Perturbation theory (first order and non – degenerate). Application of variation method and perturbation theory to the Helium atom.

C. Angular Momentum:

Ordinary angular momentum, generalized angular momentum, Eigen functions for angular momentum, Eigen value of angular momentum, operator using ladder operators, addition of angular momenta, spin anti symmetry and Pauli Exclusion Principle.

D. Molecular Orbital Theory:

Huckel theory conjugated system, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc. introduction to extended Huckel theory.

SURFACE CHEMISTRY:

A. MICELLES:

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

B. ADSORPTION

Surface Tension, capillary action, pressure difference across curved surface (Laplace equation, vapour pressure of droplets) Calvin equation and Gibbs adsorption isotherm, estimation of surface area, BET Equation, surface film on liquids (Electrokinetic Phenomenon), catalytic activity of Surfaces

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 surface.

NEUTRON DIFFERATION:

Scattering of neutron by solid and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

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Book Suggested:

1. Physical Chemistry; P. W. Atkins, ELBS.
2. Introduction to Quantum Chemistry; A. K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry; Ira. N. Levine, Prentice Hall.
4. Coulson's Valence; R. Mc Weeny, ELBS.
5. Micelles Theoretical and Applied Aspects; V. Moroi, Plenum.
6. Introduction to Polymer Science; V. R. Gowarikar, N. V. Vishwanathan and J. Sridhar, Wiley Eastern.
7. Physical Chemistry of Surface; A. W. Anderson and A. Gast, Wiley.
8. Surfaces; G. Attard and C. Barnes, Oxford Univ. press.
9. Introduction to Solid state physics. Kittel, Wiley.
10. Crystal structure determination; W. Clegg, Oxford University Press.

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M.Sc .I –SEMESTER, CHEMISTRY (2023-24)

Paper – IV

ANALYTICAL CHEMISTRY & MATHS/BIOLOGY FOR CHEMISTS

Max. M : 80

Note :- 80% Questions will be asked from Part A, and 20% section(A&B) of question paper.

Questions will be asked from Part B in every

PART –A

1. Error Analysis and Statistical data Analysis:

Error, types of errors, minimization of errors, statistical treatment for error analysis, standard deviation. Relative standard deviation, Accuracy and Precision, linear least squares. Computation rules

2.X- RAY DIFFERACTION:

Bragg's condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X- Ray structural analysis of crystals, index reflections, identification of unit cells form systematic absence 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. Ramchandran diagram.

3.FOOD ANALYSIS:

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

4. ANALYSIS OF WATER POLLUTION:

Origin of waste water, types, water pollutant and their effects. Sources of water pollution, domestic, industrial, agriculture soil, and radio active wastes as sources of pollution. Objectives of analysis parameter for analysis; colour, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chloride, fluoride, silica, phosphates and different form of nitrogen. Heavy metal pollution, Public health significance of cadmium, chromium, copper, lead, manganese mercury and arsenic. General survey of instrumental technique for the analysis of heavy metals in aqueous system. Measurements of DO, BOD, and COD. Pesticides as water pollutants and analysis. Water pollution law and standards.

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PART - B

MATHEMATICS FOR CHEMISTS

(For students without mathematics in B.Sc.)

1. VECTOR AND MATRIX ALGEBRA:

a. VECTOR

Vectors, dot, cross and triple products etc. the gradient, divergence and curl vector calculus, Gauss's theorem, divergence theorem etc.

b. MATRIX ALGEBRA

Addition and multiplication, inverse, adjoint and transpose of matrices, special matrices(symmetric, Skew - symmetric, Hermitian, Skew - Hermitian, unit diagonal, unitary etc.) and their properties. Matrix equation, homogeneous, non - homogeneous linear equations and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigenvalues and eigenvectors, diagonalisation, determinants (example for Huckel theory). Introduction to tensors, polarizability and magnetic susceptibility as example.

2. DIFFERENTIAL CALCULUS:

Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational, energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.) exact and inexact differentials with their applications to thermodynamic properties.

Integral calculus, basic rules for integration, integration by parts, partial integration and substitution, Reduction formulae, application of integral calculations. Functions of several variables, partial differentiation, co-ordinate transformations (eg. Cartesian to spherical polar), curves sketching.

3. ELEMENTARY DIFFERENTIAL EQUATIONS:

Variables; separable and exact first order, differential equation, homogeneous, exact and linear equations. Application of chemical kinetics, secular equilibria and quantum chemistry etc. solution of differential equations by the power series method. Fourier series solutions of harmonic oscillator and legendre equations etc., spherical Harmonic, second order differential equation and their solution.

OR

BIOLOGY FOR CHEMIST

(For students without biology in B. Sc.)

1. CELL STRUCTURE AND FUNCTIONS:

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

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2. CARBOHYDRATES:

Conformation of monosaccharides, structure and function of important derivatives of monosaccharides, like glycosides, deoxy sugars, myoinositol, aminosugars, N-acetyl-muramic acid, disaccharides and polysaccharides. Structural poly saccharides; cellulose and chitin. Storage poly saccharides; starch and glycogen. Structure and biological functions of glycosaminoglycans or mucopolysaccharides. Carbohydrates of glucoproteins and glycolipids. Role of sugar in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism, Krebs' cycle, glycolysis, glycogenesis and glycogenolysis. Gluconeogenesis, pentose phosphate pathway.

3. LIPIDS:

Fatty acids, essential fatty acids. Structure and function of triglycerides, glycolipids, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins; composition, function, role in atherosclerosis. Properties of lipid, aggregates-micelles bilayers, liposomes and their possible biological functions. Biological membranes, Fluid Mosaic model of membrane structure. Lipid metabolism, β -Oxidation of fatty acids.

4. AMINO ACIDS, PEPTIDES AND PROTEINS:

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holding of secondary structure, α - helix, β - sheets. Super secondary structure. Triple helix. Structure of collagen. Tertiary structure of protein folding and domain structure. Quaternary structure. Amino acid metabolism, degradation and biosynthesis of amino acids. Sequence determination, chemical, enzymatic, mass spectral. Rationalization, detection. Chemistry of oxytocin and tryptophan releasing hormones (TRH)

5. NUCLEIC ACIDS:

Purine, Pyrimidine bases of nucleic acids. Base pairing via H-bonding. Structure of ribonucleic acid (RNA) and deoxy ribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it, chemical and enzymatic hydrolysis of nucleic acid. The chemical basis of heredity and overview of replication of DNA. Transcription, translation and genetic code. Chemical synthesis of mono and tri nucleosides.

BOOKS SUGGESTED FOR ANALYTICAL CHEMISTRY:

1. Analytical Chemistry; G. D. Christian, J. Wiley.
2. Quantitative Analysis; R. A. Day, Jr. and A. L. Underwood, Prentice Hall.
3. Environmental Solution Analysis; S. M. Khopkar, Wiley Eastern.
4. Basic Concept of Analytical chemistry; S. M. Khopkar, Wiley Eastern.
5. Physical Methods for Chemists; R. S. Drago, saunder college.
6. Crystal Structure Determination; W. Clegg, Oxford University Press.

BOOKS SUGGESTED FOR COMPUTER:

1. Computer and Common Sense; R. Hunt and J. Shelley, Prentice Hall.
2. Computational Chemistry; A. C. Norris.
3. Micro Computer Quantum Mechanics; J. P. Kiligbeck, Adam Hilger.
4. Computer Programming in Fortran IV; V. Rajaraman, Prentice Hall.

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5. An Advance to Digital Computer Design; V. Rajaramn and T. Radha Krishanan, Prentice Hall.

BOOKS SUGGESTED FOR MATHEMETICS FOR CHEMIST:

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

BOOKS SUGGESTED FOR BIOLOGY FOR CHEMIST:

1. Principle of Biochemistry; A. L. Lehninger, Worth Publishers.
2. Biochemistry; L. Stryer, W. H. Freeman.
3. Biochemistry; J. David, Rawan, Nein Patterson.
4. Biocvhemistry; Voet and Voet.
5. Outline of Biochemistry; E.E.Cohn and P. K. Stumpf. John Wiley.
6. Chromatography; Ledrer and Ledrer.

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MSc I-SEMESTER
LABORATORY COURSE - I (2023-24)
PHYSICAL CHEMISTRY

MM: 100

Adsorption:

To study surface tension – concentration relationship for solutions (Gibbs equation).

Phase Equilibria:

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

Chemical Kinetics :

- (i) Determination of effect of (a) change of temperatures, (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.
- (ii) Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
- (iii) Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.
- (iv) Flowing clock reaction (Ref.; Experiments in Physical Chemistry by Showrnaker).
- (v) Determination of the primary salt effect on the kinetics of ionic reaction and testing of the Bornsted relationship (iodide ions oxidized by persulphate ion).
- (vi) Oscillatory reaction.

Solutions:

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

Conductometry:

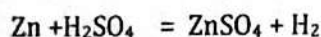
- (i) Determination of velocity constant, Order of reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide.
- (ii) Determination of solubility and solubility product of sparingly soluble salts (e.g. PbSO_4 , BaSO_4).
- (iii) Determination of the strength of strong and weak acids in a given mixture.

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- (iv) To study of effect of solvent on the conductance of AgNO_3 / acetic acid and to determine the degree of dissociation and equilibrium constant in different solvent and in their mixtures (DMSO, DMG, dioxane, acetone, water) and to test the validity of Debye- Huckle-Onsager theory.
- (v) Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's limiting law.

Potentiometry/ pH metry:

- (i) Determination of strength of halides in a mixture potentiometrically.
- (ii) Determination of the valency of mercurous ions potentiometrically.
- (iii) Determination of the strength of strong acid, weak acids in a given mixture using a potentiometer/ pH meter.
- (iv) Determination of temperature dependence of EMF of a cell.
- (v) Determination of the formation constant of silver- ammonia complex and stoichiometry of the complex potentiometrically.
- (vi) Acid - base titration in a non-aqueous media using a pHmeter.
- (vii) Determination of activity and activity coefficient of electrolytes.
- (viii) Determination of the dissociation constant of acetic acid in DMSO,DMG, acetone and dioxaneby titrating in with KOH.
- (ix) Determination of the dissociation constant of monobasic / dibasic acid by Albert-Serjeant method.
- (x) Determination of thermodynamic constant. $\Delta G, \Delta S$ and ΔH for the reaction by e.m.f. method.



POLAROMETRY:

- (i) Determination of rate constant for hydrolysis / inversion of sugar a polarometry.
- (ii) Enzyme kinetic - inversion of sucrose.

Books suggested :

1. Practical Physical Chemistry; A. M. James and F. F. Prichard Longman.
2. Findley's Practical Physical Chemistry; B. P. Levitt, Longman.
3. Experimental Physical Chemistry; R. C. Das and B. Behra Tata Mc Graw Hill

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M.Sc. I-SEMESTER
LABORATORY COURSE - II (2023-24)
ANALYTICAL CHEMISTRY
MM : 100

1 Error Analysis and Statistical data Analysis:

Calibration of volumetric apparatus, burettes, pipette, standard flask, weight box etc.

2. Volumetric Analysis:

Basic principles. Determination of Iodine and saponification values of oil sample. Determination of DO, COD, BOD, Hardness of water samples.

3. Gravimetric Analysis:

Determination of metal ions e.g. Ni, Cu etc. by gravimetric method using organic precipitants such as dimethylglyoxime, dithizone and β -hydroxyquinoline etc.

4. Chromatography:

Separation of cations and anions by

(a) Paper Chromatography (b) Column Chromatography

5. Ph metry/ Potentiometry/ Conductometry

Determination of strength of acids etc.

6. Flame Photometry/AAS/FIA/Colorimetry:

Determination of cations/anions and metal ions eg. Na^+ , K^+ , Ca^{+2} , SO_4^{2-} , NO_2^- , Fe, Mo, Cu, Zn etc.

7. Spectrophotometry:

Verification of Beer - Lambert Law. Molar absorptivity calculation, plotting graph to obtain λ_{max} etc. effect of Ph in aqueous colored system. Determination of metal ions eg. Fe, Cu, Zn, Pb etc. using inorganic reagents like SCN and organic chelating agent like dithizone, cupferron, hydroxyquinoline etc. in aqueous / organic phase in the presence of surface active agents.

Nephelometry/Turbidimetry:

Determination of chloride, phosphate, sulphate, turbidity etc.

8. Application of Computer in Chemistry :

As specified in theory paper. Books suggested:

1. Vogel's Test book of Quantitative Analysis revised; Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.
2. Findley's Practical Physical Chemistry; B. P. Lavitt, Longman.
3. Experimental Physical Chemistry; R. C. Das and B. Behera, Tata McGraw Hill.

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Instruction to Practical Examiners in Chemistry Semester -I

1. The Board of Examiners; one external and one internal for each branch will meet to decide the exercises and other matter in connection with the conduct of practical examinations

S. No.	Lab. Course (branch)	Max. Marks	Duration
1.	I- Physical Chemistry	100	5 hrs.
2.	II- Analytical Chemistry	100	5 hrs.

2. The distribution of marks is as under. Marks of Ex-students are given in parentheses.

For Lab. Course -I (Physical Chemistry):

(a) One practical exercise	50 (70) marks
(b) Viva voice and manipulation	20 (30) marks
(c) Sessional	30 (...) marks
Total 100 (100) marks	

As far as possible all the exercises as laid down in the syllabus are set. The scale of marking will be determined by examiners in accordance with the nature of exercises.

For Lab. Course -II (Analytical Chemistry):

(a) One practical exercise	50 (80) marks
(b) Viva voice and manipulation	20 (20) marks
(c) Sessional	30 (...) marks
Total 100 (100) marks	

As far as possible all the exercises as laid down in the syllabus are set. The scale of marking will be determined by examiners in accordance with the nature of exercises.

Sessional marks will be awarded by External Examiner in consultation with the internal Examiner

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GOVT. E. RAGHVENDRA RAO (AUTONOMOUS) P. G. SCIENCE
COLLEGE, BILASPUR (C. G.)

SYLLABUS

M. Sc. CHEMISTRY

2023-24

SEMESTER - II

DEPARTMENT OF CHEMISTRY

M.Sc. II - SEMESTER, CHEMISTRY

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THEORY PAPERS

PAPER	TITLE	TEACHING DURATION
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II	Organic Chemistry	70 hrs
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IV	Spectroscopy	70 hrs

PRACTICAL / LABORATORY COURSE

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Practical:-

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II organic chemistry	100	36

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M.Sc. II- SEMESTER, CHEMISTRY (2023-24)

PAPER-I

INORGANIC CHEMISTRY

Max. Marks :80

1. Stereochemistry and Bonding in main group compounds ;

VSEPR, Walsh diagram (Tri and Penta atomic molecule) $d\pi - p\pi$ bonds, bent rule and energetic of hybridization, some simple reactions of covalently bonded molecules .

2. Metal Ligand bonding :

Limitation of crystal field theory, Molecular Orbital theory, Octahedral, tetrahedral and square planer complexes, π bonding & Molecular orbital theory.

3. Metal π -Complexes:

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

4. Metal Clusters :

Higher boranes, carboranes , metalloboranes and metallocarboranes , Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds .

5. Crown ether complexes and cryptands, inclusion compounds:

6. Isopoly and Heteropoly Acid & salt

Books Suggested

1. Advanced Inorganic Chemistry : F.A. Cotton and Wilkinson : John Wiley
2. Inorganic Chemistry : J. E. Huhey, Harpes & Raw
3. Chemistry of the Elements : N. N. Greenwood & A. Emshow , Pergamon
4. Inorganic Electronic Spectroscopy : A. B.P. Lever, Elsevier
5. Magnetochemistry : R. L. Carlin, Springer Cerlag
6. Comprehensive coordination Chemistry eds. G. Wilkinson, R.D. Gillers and J. A. McCleverty, Pergamon
7. Chemical Applications of Group Theory : F.A. Cotton

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M.Sc. II-SEMESTER, CHEMISTRY (2023-24)

PAPER - II

ORGANIC CHEMISTRY

(Reaction Mechanism)

Max.Marks : 80

Reaction Intermediates :

Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, Carbenes, Nitrenes, and Benzyne. Application of NMR in detection of carbocation

1. Electrophilic Substitution reactions :

- Aliphatic electrophilic substitution : Bimolecular mechanism : S_E2 , S_E1 and S_Ei mechanism, electrophilic substitution accompanied by double bond shifts Effect of substrates, leaving group and the solvent polarity on the reactivity.
- Aromatic electrophilic substitution : The Arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack orientation in other ring system. Quantitative treatment of reactivity in substrates and electrophiles, Diazonium coupling, Gattermann Koch reaction, Vilsmeier reaction.

2. Nucleophilic Substitution reactions :

- Aliphatic nucleophilic substitution : The S_N2 , S_N1 , mixed S_N1 , and S_N2 and SET mechanisms, the neighbouring group mechanism, neighbouring group participation by π and σ bonds. The S_N1 mechanism. Nucleophilic substitution at an Allylic, aliphatic trigonal and at a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, ambident nucleophile, regioselectivity.
- Aromatic nucleophilic substitution : The S_NAr , S_N1 , benzyne and $S_{RN}1$ mechanisms. Reactivity - effects of substrate structure leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangement.

4. Free Radical reactions :

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

5. Addition to carbon-carbon Multiple Bonds :

Mechanism and stereochemical aspects of addition reactions involving electrophiles. Nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds. Hydrogenation of aromatic rings. Hydroborations. Michael reaction, Sharpless asymmetric epoxidation.

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6. **Addition to carbon-Hetero Multiple bonds :**

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

7. **Elimination reactions :**

The E2 and E1 and E1cB Mechanism and their spectrum, Orientation of double bond Reactivity - effects of substrate structures, attacking base, the leaving group and the medium.

Book Suggested

1. Advanced Organic Chemistry - Reaction Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry - F.A. Carey and R.K. Sundberg, Plenum.
3. A Guide book to Mechanism in Organic Chemistry - Peter Syke, Longman.
4. 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 and Professional.
8. Pericyclic Reaction - S.M. Mukherji, Macmillan India.
9. Reaction Mechanism in Organic Chemistry - S.M. Mukherji and S.P. Singh, Macmillan.
10. Stereochemistry of Organic compounds - D. Nasirpuri, New Age International.
11. Stereochemistry of Organic Compounds - P.S. Kalsi, New Age International.

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MSc II-SEMESTER, CHEMISTRY (2023-24)

PAPER - III

PHYSICAL CHEMISTRY

(Kinetics & Energetics)

Max.Marks : 80

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 oscillatory reactions (Belousov-Zhabotinsky reaction), homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and nuclear magnetic resonance method.

2. THERMODYNAMICS:

A. Classical Thermodynamics:

Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems : Excess functions for non-ideal solutions. Activity, Activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, ionic strength.

B. Statistical Thermodynamics:

Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions - translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition function, application of partition function. Heat capacity behavior of solids - chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac statistics, distribution law and application to metal. Bose-Einstein statistics - distribution law and application to helium.

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3. ELECTROCHEMISTRY :

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

Electroanalysis - influence of various parameters, Hydrogen electrode. Bio-electrochemistry, threshold membrane phenomena, Nernst-Planck equation. Hodgins-Huxley equation, core conductor models, electrocardiograph. Polarography theory, Ilkovic equation, half wave potential and its significance, Introduction to corrosion, homogeneous theory, forms of corrosion monitoring and prevention methods.

Book Suggested

1. Physical Chemistry - P.W. Atkins, ELBS
2. Introduction to Quantum Chemistry - A.K.Chandra, Tata McGraw Hill
3. Quantum Chemistry - Ira N. Levine, Prentice Hall
4. 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; McMillan.
7. Micelles, Theoretical and Applied Aspects - V. Moroi, Plenum.
8. Modern Electrochemistry Vol. I and II - J.O.M. Bockris and A.K.N. Reddy, Plenum.
9. Introduction of Polymer Science - V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar Wiley Eastern

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M.Sc. II -SEMESTER, CHEMISTRY (2023-24)

PAER - IV

SPECTROSCOPY

Max.Marks : 80

1. Unifying Principles :

Electromagnetic radiation, Interaction of Electromagnetic radiation with matter - absorption, emission, transmission, reflection, refraction, dispersion, polarisation and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, results of the time dependent perturbation theory, transition moment. selection rules, intensity of spectral lines. Born Oppenheimer approximation, rotational, vibrational and electronic energy levels.

2. 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

3. Vibrational Spectroscopy :

A. 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, Break down 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.

B. 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 Antistokes Raman Spectroscopy (CARS).

4. Electronic Spectroscopy

A. Atomic Spectroscopy : Energy of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atom.

B. Molecular Spectroscopy : Energy level molecular orbitals, vibronic transitions, vibrational progression and geometry of the excited states. Franck-Condon principle. electronic spectra of polyatomic molecules, Emission spectra, radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

C. Photo Electronic Spectroscopy : Basic principles, photo-electric effect, ionisation process, Koopman's theorem Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA Auger electron spectroscopy, basic idea.

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5. Magnetic Resonance Spectroscopy

A. 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 (ABX, AMX, ABC, A2B2 etc.) spin decoupling basic ideas about instruments. NMR studies of nuclei other than proton - ^{13}C , ^{19}F and ^{31}P . FT - NMR, advantages of FT - NMR, use of NMR in medical diagnostics.

B. Electron Spin Resonance Spectroscopy : Basic principle, zero field splitting and kramer's degeneracy, factors affecting the 'g' value Isotropic and anisotropic hyperfine coupling constants spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.

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

6. Photo acoustic Spectroscopy :

Basic principles of photoacoustic spectroscopy (PAS), PAS-gases and condensed systems, chemical and surface application.

Book Suggested :

1. Modern Spectroscopy - J.M. Hollas, John Wiley
2. Applied Electron Spectroscopy for chemical Analysis - Ed.H. Windawi and F.L. Ho, Willey Interscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in inorganic chemistry - R.V. Pansh, Ellis Harwood.
4. Physical Method in Chemistry - R.S. Drago, Saunders College.
5. Introduction to Molecular Spectroscopy - G.M. Barrow, McGraw Hill.
6. Basic Principle of Spectroscopy - R. Chang, McGraw Hill.
7. Theory and application of UV spectroscopy - H.H. Jaffe & M. Orchin, IBH Oxford.
8. Introduction to photoelectron spectroscopy - P.K. Ghost, John Wiley.
9. Introduction to magnetic resonance - A Carrington & A.D. MacLachalan, Harper &

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LABORATORY COURSE - I, (2023-24)

M.Sc. II-SEMESTER

INORGANIC CHEMISTRY

MM 100

1. Qualitative analysis of mixture containing eight radicals (including some less common metal ions) among the following by common method (preferably semi-micro method) :

Basic Radicals : Ag, Pb, Hg, Cu, Cd, Bi, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, NH_4 , Ce, Th, Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt

Acid Radicals : Carbonate, Sulphate, Sulphite, Nitrite, Acetate, Fluoride, Chloride, Bromide, Iodide, Nitrate, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferrocyanide, Ferricyanide, Chromate, Arsenite, Arsenate, Permanganate.

2. Quantitative Analysis:- Analysis involving two of the following in ores, alloys, or mixture in solution - one by volumetric and other by gravimetric method -

Ag, Cu, Fe, Cr, Mn, Ni, Zn, Ba, Ca, Mg, Chloride, Sulphate

3. Estimation of :

- a) Phosphoric acid in commercial orthophosphoric Acid.
- b) Boric acid in Borax
- c) Ammonium ion in ammonium salt.
- d) MnO_2 in Pyrolusite.
- e) Available chlorine in bleaching powder.
- f) H_2O_2 in commercial sample.

4. A. Preparation of selected Inorganic compounds and study of their properties by various methods including IR, Electronic spectra, Mossbauer, ESR, Spectra and Magnetic susceptibility measurements etc.

(i) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$

(ii) Prussian Blue, Turnbull's Blue

(iii) $[\text{Co}(\text{NH}_3)_6(\text{Co}(\text{NO}_2)_6)]$

(iv) $[\text{Ni}(\text{NH}_3)_4]\text{Cl}_4$

(v) Ni (dmg)

(vi) $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$

4B. Project submitted on the following compound with theoretical studies i.e. Preparation, properties, spectral data like UV, ESR, NMR, Moss bar, Magnetic properties including geometrical structure

(i) $\text{VO}(\text{acac})_2$ (iii) $\text{Na}[\text{Cr}(\text{NH}_3)_2(\text{SCN})_4]$

(ii) $\text{Cis-K}[\text{Cr}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O})_2]$ (iv) $\text{Mn}(\text{acac})_3$ (v) $\text{Hg}[\text{Co}(\text{SCN})_4]$

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ORGANIC CHEMISTRY

MM- 100

1. Qualitative analysis

Separation, purification and identification of binary mixture (one liquid and one solid), using T.L.C. and column chromatography, Chemical test, I.R. spectra may be used for functional group identification.

2. Organic Synthesis:-

Acetylation of Cholesterol and separation of Cholesteryl acetate by column chromatography.

Oxidation of Adipic acid by chromic acid. Oxidation of cyclohexanol.

Grignard's reaction : Synthesis of triphenylmethanol from Benzoic acid.

Aldol condensation : dibenzalacetone from Benzaldehyde

Sandmeyer Reaction : p-chloro Toluene from Toluidine.

Friedle Craft's reaction : p-Benzoyl propanoic acid from succinic anhydride and Benzene

Aromatic electrophilic substitution : nitration and bromination of aniline/acetanilide

Products may be characterised by Spectral techniques.

3. Quantitative Analysis :

Determination of the percentage number of hydroxyl groups by Acetylation method.

Estimation of amine/phenols using Bromate Bromide solution or Acetylation method.

Estimation of Carbonyl group by hydrozane method.

Estimation of Glycine by titration.

Determination of equivalent weight of carboxylic compounds.

Estimation of carboxyl group by titration/Silver salt method.

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Instructions to Practical Examiners in Chemistry

Semester - II

1. The Board of Examiners - one external and one internal for each branch will meet to decide the exercises and other matter in connection with the conduct of practical examinations.

S.No.		Branch	Marks	Duration
1.	Lab Course-I	Inorganic Chemistry	100	08 hours
2.	Lab Course-II	Organic Chemistry	100	5 hours

2. Sessional marks will be awarded by External Examiner in consultation with the Internal Examiner.

3. The distribution of marks is as under. Marks for Ex-students are given in parentheses.

1. INORGANIC CHEMISTRY

- (a) Qualitative analysis of mixture containing not more than 8 radicals by semi-micro method only. 30 (40) marks
- (b) Quantitative analysis (involving separation) of a solution containing 2 metals, one of these is to be determined gravimetrically and the other volumetrically 20(30) marks
- (c) Viva voce and manipulation 20 (30) marks
- (d) Sessional 30 (--) marks

Total 100 (100) marks

Award of Marks :

- (a) Deduct two marks for each radical wrongly reported (No negative marks)
- (b) Gravimetric error upto 1% of the true value - award full marks i.e. 14 (16) for each additional error of 0.2% deduct 2 marks.
- (c) Volumetric error upto 1.5% - award full marks i.e. 14 (16). For each additional error of 0.2% deduct 2 marks.

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2. ORGANIC CHEMISTRY:

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|--|-----------------|
| (a) Qualitative analysis of mixture containing two organic compounds | - 30 (40) marks |
| (b) Two stage preparation | - 20(30) marks |
| (c) Viva voce and manipulation | - 20 (30) marks |
| (d) Sessional | - 30 (-) marks |
| Total | - 100 marks |

Awards of Marks:

- (a) Separation of mixture 10 (12) marks, Name of compounds 10 (12) marks, for using correct method and writing systematic procedure of identification of each compound 20(26) marks.
- (b) Preparation, first stage 10 (15) marks, second stage 10 (15) marks.

EXAMINER'S REPORTS

External examiner should be send report on the conduct examination giving the comments on following points:

1. Standard and performance of examinee.
2. Experimental work done by students during the academic session in the context of prescribed syllabi
3. Laboratory facilities.
4. Suggestions, if any.

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GOVT. E. RAGHAVENDRA RAO (AUTONOMOUS) P. G.
SCIENCE COLLEGE, BILASPUR (C. G.)

SYLLABUS

M. Sc. CHEMISTRY

2023-24

SEMESTER - III

DEPARTMENT OF CHEMISTRY

M.Sc. III- SEMESTER CHEMISTRY

GENERAL SCHEME

1. There shall be four theory papers; each of 100 marks, out of which 20 marks will be for internal assessment.
2. There will one practical/laboratory courses + Project Work of 200 marks.
3. The effective teaching hours for each theory paper are 70 hours and for practical 140 hours.
4. Practical examination will be conducted at the end of semester.

THEORY PAPERS

PAPER	TITLE	TEACHING DURATION
I	Application of Spectroscopy	70 hrs
II	Bio organic Chemistry	70 hrs
III	Chemistry of Natural Products	70 hrs
IV	Elective-A Polymer and NanoChemistry ElectiveB-Bio inorganic and Supramolecular Chemistry	70 hrs

PRACTICAL / LABORATORY COURSE

Laboratory course –I Special practical, 200 marks, duration 140 hrs and examination of 12 hours (separated over two day)

MARKS DISTRIBUTION

INTERNAL ASSESSMENT: 20marks (Test-10&Seminar-10) of each theory paper

THEORY :-

Paper	External	Internal	Passing Marks
I, II, III & IV	80	20	36

	Question Pattern		Total Marks
Section-A	Objective Question- 10	1x10	10
	Short Answer Questions-05	2x5	10
Section -B	Descriptive Question- 08 (50% Internal Choice)	15x4	60
		Grand Total	80

PRACTICAL :(Three experiments (150 Marks) + Project Work (50Marks))

I (SPECIAL) 200

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M.Sc., III- SEMESTER
CHEMISTRY (2023-24)
Paper – I
APPLICATION OF SPECTROSCOPY

Max.M-80

Application in inorganic and organic Chemistry.

- (i) **Vibrational spectroscopy :**
Symmetry and shapes of AB_2 , AB_3 , AB_4 , AB_5 AND AB_6 . Mode of bonding and ambidentate ligands, ethylene diamine and diketone complexes. Application of resonance Raman spectroscopy particularly for the study of active sites of Metallo-proteins.
- (ii) **Electron spin resonance spectroscopy :**
Hyperfine coupling. Spin polarization for atoms and transitions Metal ions. spin orbit coupling and significance of g-tensors. Application to transition metal complexes having one unpaired electron including biological system and to inorganic free radicals such as PH_4 , F_2 , $[BH_3]^-$.
- (iii) **Infra-red Spectroscopy :**
Instrumentation and sample handling. Characteristic vibrational Frequencies of alkanes, alkenes and alkynes, Aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compound (ketones, aldehydes, ester, amides, acids anhydrides and conjugated carbonyl compounds) Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones.
- (iv) **Ultraviolet and Visible Spectroscopy :**
Various electronic transition (185-800nm). Beer-Lamert law. Effect of solvent on electronic transitions, ultraviolet bands for carbonyl Compounds. unsaturated carbonyl compounds. Dienes, conjugated polyenes. Fieser- Woodward rules for conjugated dienes and conjugated carbonyl compounds , ultraviolet spectra of heterocyclic compounds. Steric Effect in biphenyls.
- (v) **Nuclear Magnetic Resonance Spectroscopy :**
General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, Chemical shift values and correlation for proton bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amides and mercapto) chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (1^{st} order spectra), virtual coupling. Stereochemistry, hindered rotation Karplus curve variation of coupling constant with dihedral angle. Simplification of complex spectra. Nuclear magnetic double resonance, contact shift reagents. solvent effects fourier transform technique, nuclear overhauser effect (NOE) Resonance of other nuclei-F.P.

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M.Sc. III- SEMESTER
CHEMISTRY(2023-24)

PAPER II
BIO ORGANIC CHEMISTRY

Max.M -80

- (i) **Introduction:**
Basic considerations. Proximity effects and molecular adaptation.
- (ii) **Enzymes:**
Introduction and historical perspective. Chemical and biological catalysis remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extractions and purification. Fischer's lock and key and Koshland's induced Fit hypothesis, Concepts and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics. Michaelis - Menten and Lineweaver- Burk plots, Reversible and irreversible inhibition.
- (iii) **Mechanism of Enzyme Action:**
Transition - state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms of chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.
- (iv) **Kinds of Reaction Catalysed by Enzymes:**
Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in isomerisation reactions, Beta-cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.
- (v) **Co-Enzyme Chemistry:**
Cofactors as derived from vitamins, coenzymes, prosthetic groups, apo-enzymes. structures and biological function coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD⁺, NADP⁺, FMN, FAD, Lipoic acid, Vitamins B₁₂ Mechanisms of reactions catalysed by above cofactors.
- (vi) **Enzyme Models:**
Host-guest chemistry, chiral recognition and catalysis. Molecular recognition. Molecular asymmetry and prochirality. Biomimetic chemistry. Crown ethers, cryptates, cyclodextrins, cyclodextrin-based enzyme models, calixarenes, ionophores, micelles, synthetic enzymes or synzymes.
- (vii) **Biotechnological Application of Enzymes:**
Large scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese making, syrup from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy. Enzymes and recombinant DNA technology.

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Book Suggested:

1. Understanding Enzymes. Trevor Palmer Hall.
2. Enzyme Chemistry Impact and Application Ed. Collin J Suckling. Chapman and Hall.
3. Enzyme Mechanisms Ed. M.I. Page and A Williams. Royal Society of Chemistry.
4. Fundamentals of Enzymology. N.C. Price and L. Sievens. Oxford University Press.
5. Immobilised Enzyme . An introduction and Application in Biotechnology Michael D Trevan John Wiley.
6. Enzymatic Reaction Mechanisms. C Walsh W.H. Freeman.
7. Enzyme Structure and Mechanism. A Fersht. W.H. Freeman.
8. Biochemistry. The Chemical Reactions of Living Cells. DE Metzler. Academic Press.
9. Principles of Biochemistry. A.L. Lehinger. Worth Publisher.
10. Biochemistry L. Stryer W.H. Freeman.
11. Biochemistry J. David Rawn. Neil Patterson.
12. Biochemistry Voet and Voet. John Wiley.
13. Outlines of Biochemistry. EE. Conn and PK. Stumpf. John Wiley.

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M.Sc. III- SEMESTER
CHEMISTRY (2023-24)

Paper – III
CHEMISTRY OF NATURAL PRODUCTS

Max.M-80

1. **Terpenoids and Carotenoids:**
Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule.
Structure determination stereochemistry biosynthesis and synthesis of the following representative molecules: citral.
Geraniol, α -Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol and β Carotene.
2. **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, synthesis and biosynthesis of the following Ephedrine.(+) - Coniine, Nicotine, Atropine, Quinine and Morphine.
3. **Steroids:**
Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon stereochemistry. Isolations, structure determination & synthesis of cholesterol. Bile acids. androsterone, testosterone. Estrone, Progesterone, Aldosterone. Biosynthesis of steroids.
4. **Plant pigments:**
Occurrence, Nomenclature & general methods of structure determination isolation & synthesis of Apigenin, Luteolin. Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin, Biosynthesis of flavonoids; Acetate pathway and Shikimic acid pathway.

Books suggested:

1. Natural products chemistry and biological significance J mann. R S Davidson J B. Hodds D V Banthorpe and J B Harborne, Longman Essex.
2. Organic chemistry. vol2, I L Finar, elbs.
3. Stereoselective synthesis a practical approach, M Nogradi. vch.
4. Rodd's chemistry of carbon compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, biological and pharmacological properties of medicinal plants from the Americas. Ed Kurt Hostettmann, M.P. Gupta and A. Marston : Harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm. Harwood Academic Publishers.
7. New trends in natural product chemistry, Atta-ur-Rahman and M, I Choudary Harwood Academic publishers.
8. Insecticides of Natural Origin. Sukh Dev. Harwood Academic Publisher

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M.Sc. III- SEMESTER
CHEMISTRY (2023-24)

PAPER – IV (Elective-A)
POLYMER & NANOCHEMISTRY

Max.M-80

- 1 **Basic concepts**-Monomers, repeat units, degree of polymerization. Classification of polymers. Homo-polymers, copolymers; Linear, branched and cross linked polymers : Random, alternating, block and graft polymers; Tacticity of polymers. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

Polymer Properties and Characterization

Crystalline melting point and glass transition temperature and factors affecting T_m and T_g . 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

- 2 **Kinetics and Mechanism of Polymerization**

Mechanism of condensation polymerization: addition polymerization — free radical, cationic, anionic, coordination and copolymerization.

Kinetics and statistics of stepwise polymerization — reactivity and molecular size, kinetics and statistics, molecular weight control. Kinetics of free radical chain polymerization, equation for kinetic chain length, degree of polymerization and chain transfer; kinetics of cationic polymerization: kinetics of anionic polymerization. Kinetics of heterogeneous polymerization using Ziegler Natta catalysts.

- 3 **Polymer Processing**

Plastics, elastomers and fibers, compounding. Processing techniques: Calendering, diecasting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fiber spinning.

Properties of Commercial Polymers-Polyethylene, Polyvinyl chloride, polyamides, polystyrene, phenolic resins, epoxy resins and silicon polymers, Functional polymers- fire retarding polymers and electrically conducting polymers, Biomedical Polymers- contact lens, dental polymers. Artificial heart, Kidney, Skin and blood cells

- 4 **Introduction to Nano-materials**

Properties and uses of bulk and nano-materials; Optical, electrical and magnetic properties of nano-materials; quantum confinement, role of size and shape in nano-materials.

Synthesis of nano-materials and Applications

Synthesis of nano-crystals by reduction, solvo-thermal synthesis

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photochemical synthesis, electrochemical synthesis, semiconductor nano-particles by arrested precipitation. Synthesis of nano-particles by green routes, thermolysis routes and sono-chemical routes, sol-gel, micelle and micro-emulsion methods. Important Applications

REFERENCE BOOKS

1. Polymer Science, Gowarikar, Vishwanathan, Sridhar, Wiley Eastern.
2. Text book of Polymer Science, F.W. Billmeyer, Jr. Wiley
3. Contemporary Polymer Chemistry, Alcock and Lambe, Prentice Hall.
4. Physics and Chemistry of Polymers, J.M.G. Cowie, Blackie, Acad and Professional.
5. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R.M. Otanbrite.

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M.Sc. III- SEMESTER
CHEMISTRY (2023-24)

PAPER – IV (Elective-B)
BIO INORGANIC & SUPRAMOLECULAR CHEMISTRY

- 1 **Metal Storage Transport and Biomineralization**
Ferritin, transferring and siderophores
Calcium in Biology
Calcium in living cells, transport and regulation, molecular aspects of intra molecular processes, extracellular binding proteins
Metal-Nucleic Acid Interactions
Metal ions and metal complex interactions .Metal-nucleic acids complexes.
- 2 **Metalloenzymes**
Zinc enzymes- carboxy peptidase and carbonic anhydrase .Iron enzymes- catalase peroxidase and cytochromeP-450.Copperenzymes-superoxide dismutase.
Molybdenum oxa transferase enzymes - xanthine oxidase. Cobalt enzyme- vitamin B12.
Metals in Medicine
Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.
- 3 **Supramolecular Chemistry**
Concepts and language.
Molecular recognition
Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of co receptor molecules and multiple recognition. Supramolecular reactivity and catalysis.
- 4 **Supramolecular Chemistry**
Transport processes and carrier design. Supramolecular devices .Supramolecular photochemistry, Supramolecular electronic, ionic and switching devices. Some examples of self assembly in supramolecular chemistry.

REFERENCEBOOKS:

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M.Berg, University Science Books.
2. Bioinorganic Chemistry, J.Bertini, H.B Gray, S.J.LippardandJ. S. Valentine, University Science Books.
3. Inorganic Biochemistry Vol I and II ed. G.L.Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry, Vols 1 8 and 38 ed. J.J. Lippard, Wiley.5
5. Supramolecular Chemistry, J.M.Lehn, VCH.

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M.Sc. III- SEMESTER
CHEMISTRY

LAB. COURSE GENARAL (2023-24)

MM-150;

Duration-8 hrs .

NOTE:

(1)Part-A(laboratory course (General))will be of 08hrs duration. The examinee will have to perform three experiments (one each from Section A, B, and C).These experiments will be of 30 marks each and 30 marks each will be allotted for viva-voce and 30 marks for sessional work.

(2) Part- B Project work of 50 marks.

PART-A

LABORATORY COURSE -(GENERAL)

SECTION – A (INORGANIC CHEMISTRY)
INSTRUMENTAL METHODS AND ANALYTICAL TEFHNIQUES:

1. Spectrophotometric Determinations.
 - a. Manganese/Chromium/Vanadium in steel sample.
 - b. Nickel/Molybdenum/Tungsten/Vanadium/uranium by extractive spectrophotometric method.
 - c. Fluoride/Nitrite/Phosphate/Nitrate.
 - d. Iron-phenanthroline complex:Job's method of continuous variations.
 - e. Zrconium-Alizarine red-s complex:Mole-Ratio method.
 - f. Copper-Ethylene diamine complex:Slope- Ratio method.
- B. pH metry:
Stepwise proton-ligand and metal stability constant of complexes by Irving-Rossoti methods.
- C. Plarography:
Composition and stability constant of complexes.
- i. Flame Photometric Determinations:
 - a. Sodium and Potassium when present together.
 - b. Lithium/Calcium/Barium/Strontium.
 - c. Cadmium and magnesium in tap water.
- ii. Nephelometric Determinations:
 - a. Sulphate.
 - b. Phosphate.
 - c. Silver.
- F. Separation and Quantitative estimation of binary and ternary Mixtures by the use of following separation techniques:-
 - i. Paper chromatography – Cd and Zn,Zn and Mg.
 - ii. Thin-layer chromatography-separation of Ni,Mg,Co and Zn.Determination of R_f values.

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- iii. Ion exchange.
- iv. Solvent extraction.
- v. Electrophoretic separation.

SECTION - B (ORGANIC CHEMISTRY)

a. Quantitative organic analysis:

- vi. Estimation of S by Messenger's method
- vii Estimation of N by Kjeldahl method.
- viii Estimation of halogen by Fusion method.

a. Functional group estimation:

- ix. Estimation of aniline.
- x. Estimation of amino group by acetylation method.
- xi. Estimation of hydroxyl group by acetylation method.
- xii. Estimation of carbonyl group by hydrazone formation method.

a. Chromatography:

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

SECTION-C (PHYSICAL AND ANALYTICAL CHEMISTRY) PHYSICAL CHEMISTRY:

Conductometry:

- i. To verify Debye Huckel and Onsager limiting law for strong electrolyte.
- ii. To determine the degree of hydrolysis constant of NH_4Cl /aniline hydrochloride at room temperature.
- iii. To determine the basicity of an organic compound
- iv. To determine the equivalent conductance of an electrolyte at infinite dilution and determine the dissociation constant.

Colorimetry:

- v. To determine the indicator constant pK_{in} of methyl red spectrophotometrically.
- vi. To verify additivities of absorbances of a mixture of a coloured substance in a solution using KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ solution.

pH metry:

- i. To determine pK of given dibasic and tribasic acid.
- ii. To determine the pH of various mixture of acetic acid and Na- acetate in aqueous solution and hence determine the dissociation constant of the acid.

D. Potentionmetry:

- i. Titrate ferrous ammonium sulphate against $\text{K}_2\text{Cr}_2\text{O}_7$ / KMnO_4 and determine the dissociation constant of the acid.
- ii. To determine the ionization constant of polybasic acid.

Distribution coefficient:

- i. To determine the formula of the complex formed between cupric ion and ammonia by distribution method.

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- ii. To determine the equilibrium constants of the following reaction.
Partial molar volume:
- i. Determine the partial molar volume of NaCl in aq. solution at room temperature.

ANALYTICAL CHEMISTRY:

1. Preparation of homo-and hetero-polyacids of Sb, V, Nb, Ta, Cr, Mn, W etc and study their properties.
2. Determine of pH_a of weak acids by pH metric and spectrophotometric methods.
3. Determination of distribution ratio and distribution coefficient of organic and inorganic compounds.
4. Separation of organic compounds by the chromatographic techniques i.e. TLC, Paper and column.
5. Analysis of carbohydrates, amino acids, proteins etc.
6. Analysis of pharmaceutical materials preservatives, flavour, additives etc.
7. Application of redox titration for analysis of Sn (IV), Fe(III), Cr(VI), and Mn (VII).
8. Analysis of ore, mineral, alloys.
9. Determination of equilibration constant and composition of complexes.
10. Determination of determination / polymerization constant.

PART-B

Project work

M.M.-50

Group of students will select one of the project work from the following list and completed with proper reporting at the time of practical examination.

1. Lab. techniques, preparations & reporting.
2. Industrial survey, visit and reporting
3. Teaching learning exchange programme with reporting in adopted +2 schools.

Books:

1. Text book of Quantitative Analysis by A.I. Vogel.
2. Experimental Physical Chemistry by Das & Behra.
3. Practical Physical Chemistry by Alexander Fendlay

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**GOVT. E. RAGHAVENDRA RAO (AUTONOMOUS) P. G. SCIENCE
COLLEGE, BILASPUR (C. G.)**

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***M. Sc. CHEMISTRY
2023-24***

SEMESTER - IV

DEPARTMENT OF CHEMISTRY

MSc, IV- SEMESTER, CHEMISTRY

GENERAL SCHEME

1. There shall be four theory papers; each of 100 marks, out of which 20 marks will be for internal assessment.
2. There will be one practical/laboratory course + Project Work of 200 marks.
3. The effective teaching hours for each theory paper are 70 hours and for practical 140 hours.
4. Practical examination will be conducted at the end of semester.

THEORY PAPERS

PAPER	TITLE	TEACHING DURATION
I	Photo Chemistry & Solid State Chemistry	70 hrs
II	Bio-Physical & Environmental Chemistry	70 hrs
III	Medicinal Chemistry	70 hrs
IV	Heterocyclic Chemistry	70 hrs

PRACTICAL / LABORATORY COURSE

Laboratory course –I Special practical, 200 marks, duration 140 hrs and examination of 12 hours (separated over two days)

MARKS DISTRIBUTION

INTERNAL ASSESSMENT: 20 marks (Test-10 & Seminar-10) of each theory paper

THEORY :-

Paper	External	Internal	Passing Marks
I, II, III & IV	80	20	36

	Question Pattern		Total Marks
Section-A	Objective Question- 10	1x10	10
	Short Answer Questions-05	2x5	10
Section -B	Descriptive Question- 08 (50% Internal Choice)	15x4	60
		Grand Total	80

PRACTICAL : (Three experiments (150 Marks) + Project Work (50 Marks))

I (SPECIAL) 200

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M.Sc. IV- SEMESTER
CHEMISTRY (2023-24)

Paper - I
PHOTO CHEMISTRY & SOLID STATE CHEMISTRY

Max.M-80

A. PHOTOCHEMISTRY :

- (i) **Photochemical reaction:**
Interaction of electromagnetic radiation with matter, type of excitations. Fate of excited molecule. Quantum yield of transfer of excitation energy. actinometry.
- (ii) **Determination of reaction mechanism:**
Classification, rate constant and life times of reactive energy states- determination of rate constants of reactions. Effect of light intensity on the rate of photo chemical reactions Types of Photochemical reactions- photo-dissociation, gas phase photolysis.
- (iii) **Photochemistry of Alkenes:**
Intermolecular reactions of olefinic bond,-geometrical isomerism, cyclisation reactions rearrangement of 1,4-and 1,5-dienes.
- (iv) **Photochemistry of carbonyl compounds:**
Intermolecular reaction of carbonyl compounds- Saturated, cyclic and acyclic, beta, gamma - unsaturated and alpha ,beta-unsaturated compounds. Cyclohexadienones, Intermolecular cyclo addition reactions- dimerisation and oxetane formation.
- (v) **Photochemistry of Aromatic compounds:**
Isomerisations, additions and substitutions.
- (vi) **Miscellaneous Photochemical Reaction:**
Photo-Fries reaction of anilides, Photo-Fries rearrangement. Barton reaction, singlet molecular oxygen reactions, Photochemical formation of smog, Photodegradation of polymers, Photochemistry of vision.

B. SOLID STATE CHEMISTRY:

- (i) **Solid State Reaction:**
General principles, experimental procedure, co-precipitation as a precursor to solid state reactions kinetics of solid state reactions.
- (ii) **Crystal Defects and Non - Stoichiometry:**
Perfect and imperfect crystals, intrinsic and extrinsic defects, point defects. line and plane defects, vacancies-Schottky defects and Frankel defects. Thermodynamics of Schottky and Frankel defect formation, colour centers, non-stoichiometry and defects.
- (iii) **Electronic properties and Band theory:**
Metals insulators and semi conductors, electronic structure of solids-band theory, band structure of metals, insulators semiconductors intrinsic and extrinsic semi conductors. doping semi conductors, p-n Junction, super conductors. Optical properties-optical reflectance, photo conduction. photoelectric effects.

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- (iv) **Magnetic properties:** classification of materials, Quantum theory of paramagnetics- co-operative phenomena - magnetic domains, hysteresis.
- Organic solids:**
Electrically conducting solids, organic charge transfer complex. Organic metals. new superconductors.

Books Suggested:

1. Fundamentals of photochemistry, K.K.Rohtagi-Mukherji, Wiley-Eastern.
2. Essentials of molecular photochemistry, A.Gilbert & Baggott Backwell scientific publication.
3. Molecular photochemistry N.J.Turro W.A.Benjamin.
4. Introductory photochemistry A. Cox & T.Camp Mc GrawHill.
5. Photochemistry R.P.Kundall A.Gilbert Thomson Nelson.
6. Organic photochemistry J.Coxon & B. Halton Cambridges University Press.
7. Solid state chemistry & its Application A.R.West Plenum.
8. Principles of the solid state, H.V.Keer, Wiley Eastern.
9. Solid state chemistry N.B.Hannay
10. Solid state chemistry D.K.Chakrabarty New Age International.

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M.Sc. IV- SEMESTER
CHEMISTRY (2023-24)

PAPER II
BIO PHYSICAL CHEMISTRY

Max.M-80

- (i) **Biological cell and its constituents:**
Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transition.
- (ii) **Bioenergetics:**
Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.
- (iii) **Statistical mechanics in biopolymers:**
Chain configuration of macromolecules, statistical distribution end to end dimensions, calculation of average dimensions for various chain structures, polypeptide and protein structures, introduction to protein folding problem.
- (iv) **Biopolymer interactions:**
Forces involved in biopolymer interactions, Electrostatic changes and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.
- (v) **Thermodynamics of biopolymer solutions:**
Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical systems.
- (iv) **Cell Membrane and Transport of Ion:**
Structure and function of Cell membrane, ions transport through Cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction.
- (vii) **Biopolymer and their Molecular Weights:**
Evaluation of size, shape, molecular weight and extent of hydration of biopolymer by various experimental techniques, Sedimentation equilibrium, hydrodynamic methods, diffusion, sedimentation velocity viscosity, electrophoresis and rotational motions.
- (viii) **Diffraction Methods:**
Light scattering, low angle X-ray scattering X-ray diffraction and photo correlation spectroscopy. ORD.

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Book Suggested:

1. Bioorganic Chemistry. A Chemical Approach to Ezyme Action, H. Dugas and C Penny. Springer-verlag.
2. Macromolecules. Structure and Function F. Wor;d. Prentice Hall.
3. Standard Method of Chemistry Analysis, F.J. Welcher. Vol III, Van Nostrand Reinhold Co.

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M.Sc. IV- SEMESTER
CHEMISTRY (2023-24)
Paper – III
MEDICINAL CHEMISTRY

Max.M-80

- i. **Pharmacokinetics:**
Introduction to drug absorption, disposition, elimination using pharmacokinetics important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention uses of pharmacokinetic in drug development process.
- ii. **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.
- iii. **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.
- iv. **Local Antiinfective drugs:**
Introduction and general mode of action. synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapson, aminosalicylic acid, isoniazid, ethionamid, ethambutal, fluconazole, econazole, griseofulvin, chloroquin and primaquin.
- 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.
- vi. **Antibiotics:**
Cell wall bio synthesis, inhibitors, -lactam rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin-G, penicillin-V, ampicillin, amoxycillin, chloramphenicol, cephalosporin, tetracycline and streptomycin.

Books suggested:

1. Introduction to Medicinal Chemistry, A. Gringuage Wiley-VCH
2. Wilson and Gisvolds Text Book of Organic Medicinal and Pharmaceutical Chemistry ED. Robert F. Dorge.
3. An Introduction to drug design, S.S. Pandaya and J.R. Dimmock, New Age International.
4. Burgers Medicinal Chemistry and Drug Discovery, Vol-1 (Chapter-9 and Ch-14) Ed ME Wolff, John Wiley.
5. Goodman and Gilman's Pharmacological Basis of Therapeutics McGraw-Hill.
6. The Organic Chemistry of Drug and Drug Action, R.B. Silverman Academic Press.
7. Strategies for Organic Drug Synthesis and Design D Lednicer, John Wiley.

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M.Sc. IV- SEMESTER
CHEMISTRY (2023-24)
Paper – IV (Elective-A)
Heterocyclic Chemistry

Max.M-80

- i. **Nomenclature of Heterocycles:**
Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles.
- ii. **Aromatic Heterocycles:**
General chemical behaviour of aromatic heterocycles. classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^1H NMR-spectra, empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Hetero aromatic reactivity and tautomerism in aromatic heterocycles.
- iii. **Non-aromatic Heterocycles:**
Strain-bond angle and torsional strains and their consequences in small ring heterocycles conformation of six-membered heterocycles with reference to molecular geometry. barrier to ring inversion. pyramidal inversion and 1,3-diaxial interaction. Stereo-electronic effects-anomeric and related effects. Attractive interactions - hydrogen bonding and intermolecular nucleophilic-electrophilic interactions.
- iv. **Heterocyclic Synthesis:**
Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions.
- v. **Small Ring Heterocycles:**
Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes.
- vi. **Benzo-Fused Five-Membered Heterocycles :**
Synthesis and reactions including medicinal application of benzopyrroles, benzofurans and benzothiophenes.
- vii. **Six-Membered Heterocycles with One Heteroatom**
Synthesis and reaction of pyrylium salts and pyrones and their comparison with pyridinium and thiopyrylium salts and pyridones. Synthesis and reaction of quinolizinium and benzopyrylium salts. coumarins and chromones.
- viii. **Six-Membered Heterocycles with Two or More Heteroatoms:**
Synthesis and reaction of diazines, triazines, tetrazines and thiazines.
- ix. **Seven-and large Membered Heterocycles:**
Synthesis and reaction of azepines, oxepines. thiepinines, diazepines, thiazepines, azocines, diazocines, dioxocines and dithiocine

Book Suggested:

1. Heterocyclic Chemistry Vol 1-3, R.R.Gupta, M.Kumar and V.Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T.Eicher and S.Hauptmann, Thieme.
3. Heterocyclic Chemistry J.A.Joul, K.Mills and G.F.Smith Chapman and Hall.
4. Heterocyclic Chemistry T.L.Gilchrist, longman Scientific Technical.
5. An Introduction to the Heterocyclic Compounds, R.M.Acheson, John Wiley.
6. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W.Rees eds Pergamon Press.
7. Contemporary Heterocyclic Chemistry; G. R. Newkome and W. W. Paudler Wiley Inter Science

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M.Sc. IV- SEMESTER
CHEMISTRY (2023-24)
Paper – IV (Elective –B)
ENVIRONMENTAL & GREEN CHEMISTRY

- (i) **Environment:**
Introduction, Composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere. Biogeochemical cycles of C, N, P, S, and O. Biodistribution of elements.
- (ii) **Hydrosphere:**
Chemical composition of water bodies-lakes, streams, rivers and wet lands etc. Hydrological cycle, Aquatic pollution-inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants.
Water quality parameters-dissolved oxygen, biochemical oxygen demand, solids, metals, sulphate, phosphate, nitrate. Micro-organism.
Water quality standard. Analytical methods for measuring BOD, DO, COD, F oils, metals (As, Cd, Cr, Hg, Pb, Se etc). Residual chloride and chlorine demand. Purification and treatment of water.
- (iii) **Industrial pollution:**
Cement, sugar, distillery, paper and pulp, thermal power plants. Nuclear power plants. Metallurgy, polymers, drugs etc. Radionuclide analysis, Disposal of wastes and their management.
- (iv) **Introduction to Green Chemistry**
What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry
- (v) **Principles of Green Chemistry**
Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity Emerging Green solvents & Green Catalysis, Alternative Green energy Sources & Some important green synthesis, Future Trends in green Chemistry and sustainable development, Some real world cases in green Chemistry

Book Suggested:

1. Environmental Chemistry. S.E. Manahan. Lewis Publishers.
2. Environmental Chemistry. Sharma and Kaur, Krishna Publishers.
3. Environmental Chemistry. A.K. De. Wiley Eastern.
4. Environmental Pollution Analysis S.M. Khopkar, Wiley Eastern.
5. Standard Method of Chemistry Analysis, F.J. Welcher. Vol III, Van Nostrand Reinhold Co.
6. Environmental Toxicology, Ed. J. Rose. Gordon and Breach Science Publication.
7. Elemental Analysis of Airborne Particles, Ed. S. Lansberger and M. Cretchman. Gordon and Breach Science Publication.
8. Environmental Chemistry, C. Baird, W.H. Freeman.
9. Anastas, P.T. & Warner, J.K. Green Chemistry- Theory and Practical, Oxford University Press (1998).
10. Ahluwalia, V.K. & Kidwai, M.R. New Trends in Green Chemistry, Anamlaya Publishers (2005).
11. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).

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12. Cann, M.C. & Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
13. Ryan, M.A. & Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, Washington (2002).
14. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. Green Chemistry Experiments: A monograph I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore.
15. Lancaster, M. Green Chemistry: An introductory text RSC publishing, 2nd Edition.
16. Sidhwani, I.T., Saini, G., Chowdhury, S., Garg, D., Malovika, Garg, N. Wealth from waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated "A Social Awareness Project", Delhi University Journal of Undergraduate Research and Innovation

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M.Sc. IV- SEMESTER
CHEMISTRY
LABORATORY COURSE – SPECIAL (2023-24)

MM-150 ;

Duration-08 hrs .

NOTE:

(1) Part-A (laboratory course (General)) will be of 08hrs duration. The examinee will have to perform three experiments (one each from Section A, B, and C). These experiments will be of 30 marks each and 30 marks each will be allotted for viva-voce and 30 marks for sessional work.

(2) Part- B Project work of 50 marks.

PART-A

LABORATORY COURSE – (GENERAL)

SECTION-A

Multi-step Synthesis of Organic Compounds:

- i. Beckmann Rearrangement : Benzanilide from benzene
(Benzene – Benzophenone – Benzophenone oxime – Benzanilide)
- ii. Benzilic Acid Rearrangement : Benzilic acid from Benzoin
(Benzoin – Benzil – Benzilic acid)
- iii. Skraup's synthesis (Synthesis of heterocyclic compounds)
Quinoline from o-Amino phenol
- iv. p-Bromoaniline from Aniline
(Aniline – Acetanilide – p-bromoacetanilide – p-bromoaniline)
- v. p-Nitroacetanilide from Acetanilide
(Aniline – Acetanilide – Nitroacetanilide p- Nitroaniline)
- vi. m-Nitroaniline from Benzene
(Benzene – Nitrobenzene – m- dinitrobenzene – m- Nitroaniline)
- vii. Acridone from Anthranilic acid
(Anthranilic acid – o-Chlorobenzoic acid – N-Phenylanthranilic acid – Acridone)
- viii. Enzymatic Synthesis
Enzymatic reduction : Reduction of ethylacetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ethyl-3-hydroxybutanone and determine its optical purity.

SECTION – B

Extraction of Organic Compounds from Natural Sources :

- i. Isolation of caffeine from leaves.
- ii. Isolation of Casein from milk.
- iii. Isolation of lactose from milk.
- iv. Isolation of nicotine dipicrate from tobacco.
- v. Isolation of Cinchonine from cinchona bark.
- vi. Isolation of Piperine from black pepper.
- vii. Isolation of Lycopene from tomatoes.
- viii. Isolation of β -Carotene from carrots.

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

Spectrophotometric Estimations:

- i. Amino acids.
- ii. Carbohydrates.
- iii. Ascorbic acid.
- iv. Aspirin.
- v. Caffeine.

SECTION - C

Estimations : Any one of the following estimations –

- i. Halogen (ref. 2, p. 416)
- ii. Hydroxyl group (ref. 2, p. 450)
- iii. Amino group (ref. 2, p. 463)
- iv. Carboxyl group (ref. 2, p. 445)
- v. Methoxy group (ref. 2, p. 497)
- vi. Sugars (ref. 2, p. 460)

Preparation of dyes:

- i. Indigo (ref. 1, p. 980)
- ii. Alizarin (ref. 1, p. 928)
- iii. Malachite green (ref. 3, p. 344)
- iv. Methyl orange (ref. 1, p. 624, ref. 2, p. 214, ref. 3. 243)
- v. Phenyl azo B-naphthol (ref. 1, p. 622)
- vi. Other dyes of industrial importance.
- vii. Identification of a dye on textile fibers (ref. 6, p. 391. 402)
- viii. Quantitative estimation of a dye in textile fibers (ref. 5, p. 519)

PART-B

Project work M.M.-50

Group of students will select one of the project work from the following list and completed with proper reporting

1. Analysis of water sample of selected areas.
2. Study of pollution types and its effect in particular areas.
3. Sampling method and analysis of coal with collaboration of CIMFR, Bilaspur.
4. Analysis of plant extract with collaboration of Columbia Institute of Pharmacy.
5. Analysis of soil
6. Synthesis of Nano particles & Nano composite

Ref. Books:

1. A I Vogel Practical Organic Chemistry 3rd Ed. Longman Group Ltd. 1956
2. F G Mann and B G Saunders. Practical Organic Chemistry 4th ed Longman Group Ltd. 1974
3. R D Brewster C A Vannerwell W.E. McQuwan United Experiments in Organic Chemistry 2nd Ed. D Van Noster and Co inc.

Handwritten signatures and dates:
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