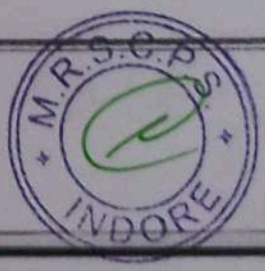
Scheme and Syllabus
of
M.Sc. Chemistry

I and II Semesters
Effective from Academic Year 2016-17 onwards

Devi Ahilya Vishwavidyalaya,
Indore (M.P.), 452001



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Scheme of Marks

M. Sc. Chemistry

(w.e.f. 2016 and onwards)

SEMESTER – I

Paper	Compulsory/Optional	Paper Title	Code (MCH)	Max. Marks
I	Compulsory	INORGANIC CHEMISTRY	401	85+ 15(CCE) = 100
II	Compulsory	ORGANIC CHEMISTRY	402	85+ 15(CCE) = 100
III	Compulsory	PHYSICAL CHEMISTRY	403	85+ 15(CCE) = 100
IV	Compulsory	GROUP THEORY & SPECTROSCOPY I	404	85+ 15(CCE) = 100
V	For Students Without Mathematics in B.Sc.	MATHEMATICS FOR CHEMISTS	405(a)	85+ 15(CCE) = 100
	For Students Without Biology in B.Sc.	BIOLOGY FOR CHEMISTS	405(b)	85+ 15(CCE) = 100
		PRACTICAL - 1. Inorganic 2. Organic 3. Physical		33 33 34 =100
		Total		600

M. Sc. Chemistry

SEMESTER – II

Paper	Compulsory/Optional	Paper Title	Code (MCH)	Max. Marks
I	Compulsory	INORGANIC CHEMISTRY	406	85+ 15(CCE) = 100
II	Compulsory	ORGANIC CHEMISTRY	407	85+ 15(CCE) = 100
III	Compulsory	PHYSICAL CHEMISTRY	408	85+ 15(CCE) = 100
IV	Compulsory	SPECTROSCOPY II & DIFFRACTION METHODS	409	85+ 15(CCE) = 100
V	Compulsory	COMPUTER FOR CHEMISTS	410	85+ 15(CCE) = 100
		PRACTICAL - 1. Inorganic 2. Organic 3. Physical		33 33 34 =100
		Total		600

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M.Sc. CHEMISTRY (SEMESTER – I)

Paper No. : I (Code-MCH-401)
Compulsory / Optional : Compulsory
Max. Marks : 100

Paper – I : Inorganic Chemistry

Unit – I	**Stereochemistry and Bonding in Main Group Compounds :** VSEPR, Walsh diagram (triatomic and penta-atomic molecules), dπ-pπ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.
Unit – II	**Metal-Ligand Equilibrium in Solution** Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by potentiometry and spectrophotometry.
Unit – III	**Reaction Mechanism of Transition Metal Complexes** Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anion reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.
Unit – IV	**Metal-Ligand bonding** Limitation of crystal field theory, molecular orbital theory for bonding in octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory.
Unit –V	**HSAB Theory** Classification of acids and bases as hard and soft; HSAB principle, theoretical basis of hardness and softness; Lewis-acid base reactivity approximation; donor and acceptor numbers, E and C equation; applications of HSAB concept.

Books Suggested :

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetiochemistry, R.1. Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. Mc-Cleverty,Pergamon.

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M.Sc. CHEMISTRY (SEMESTER – I)

Paper No. : **II (Code- MCH-402)**
Compulsory / Optional : **Compulsory**
Max. Marks : **100**

Paper – II : Organic Chemistry

Unit – I	**Nature of Bonding in Organic Molecules** Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, 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, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compound, catenanes and rotaxanes.
Unit – II	**Stereochemistry** 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 spirane) chirallity due to helical shape. Stereochemistry ofthe compounds containing nitrogen, sulphur and phosphorus.
Unit – III	**Conformational analysis and linear free energy relationship** Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity, conformation of sugars. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett equation and linear free energy relationship, substituents and reaction constants, Taft equation.
Unit – IV	**Reaction Mechanism : Structure and Reactivity** Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtir-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotopes effects.
Unit –V	**Aliphatic Nucleophilic Substitution** The SN^2, SN^1 mixed SN^1 and SN^2 and SET mechanism. The neighboring group mechanism, neighboring group participation by p and s bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl systems, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations. The SN^1 mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

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Books Suggested :

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sunderg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Comell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
9. Pericyclic Reactions, S.M. Mukherji, Macmillan, India
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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M.Sc. CHEMISTRY (SEMESTER – I)

Paper No. : **III (Code- MCH-403)**
Compulsory /Optional : **Compulsory**
Max. Marks : **100**

Paper – III : Physical Chemistry

Unit – I	**Introduction to Exact Quantum Mechanical Results** Schrödinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrödinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom and helium atom.
Unit – II	**Approximate Methods** The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate). Applications of variation method and perturbation theory to the Helium atom. **Molecular Orbital Theory** Huckel theory of conjugated systems bond and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical cyclobutadiene etc. Introduction to extended Huckel theory.
Unit – III	**Angular Momentum** Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen values of angular momentum operator using ladder operators addition of angular momenta, spin, anti-symmetry and Pauli exclusion principle.
Unit – IV	**Classical Thermodynamics** Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems : Excess function s for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems; second order phase transitions.
Unit –V	**Statistical Thermodynamics** Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and micro-canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translation, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition. Application of partition functions. Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics distribution Law and application to helium.

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

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M.Sc. CHEMISTRY (SEMESTER – I)

Paper No. : IV (Code-MCH-404)
Compulsory / Optional : Compulsory
Max. Marks : 100

Paper – IV : Group Theory & Spectroscopy I

Unit – I	**Symmetry and Group theory in Chemistry** Symmetry elements and symmetry operation, definition of group, subgroup. Conjugacy relation and classes. Point symmetry group. Schonfilies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} group to be worked out explicity). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy. Derivation of character table for C_{2v} and C_{3v} point group Symmetry aspects of molecular vibrations of H_2O molecule.
Unit – II	**Microwave Spectroscopy** Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications.
Unit – III	**Infrared Spectroscopy** Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy. P.Q.R. branches, Breakdown of Oppenheimer approximation; vibrations of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations, normal co-ordinate analysis.
Unit – IV	**Raman Spectroscopy** Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman spectroscopy (CARS).
Unit –V	**Electronic Spectroscopy** **Molecular Spectroscopy** Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radio-active and non-radioactive decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra. **Photoelectron Spectroscopy** Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectroscopy-basic idea.

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ooks suggested:

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

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M.Sc. CHEMISTRY (SEMESTER – I)

Paper No. : V [Code-405(a)]
Compulsory / Optional : Compulsory
Max. Marks : 100

Paper – V : (a) Mathematics For Chemists

(For students without Mathematics in B.Sc.)

Unit – I	**Vectors** Vectors, dot, cross and triple products etc. gradient, divergence and curl, Vector Calculus. **Matrix Algebra** Addition and multiplication; inverse, adjoint and transpose of matrices.
Unit – II	**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.).
Unit – III	**Integral Calculus** Basic rules for integration, integration by parts, partial fractions and substitution. Reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar).
Unit – IV	**Elementary Differential equations** First-order and first degree differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc. second order differential equation and their solutions.
Unit –V	**Permutation and Probability** Permutations and combinations, probability and probability theorems average, variance root means square deviation examples from the kinetic theory of gases etc., fitting (including least squares fit etc with a general polynomial fit).

Books suggested

1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2. Mathematics for chemistry, Doggett and Suiclific, Logman.
3. Mathematical for Physical Chemistry : F. Daniels, Mc. Graw Hill.
4. Chemical Mathematics D.M. Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Barante, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley.

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M.Sc. CHEMISTRY (SEMESTER – I)

Paper No. : V [Code-405(b)]
Compulsory / Optional : Compulsory
Max. Marks : 100

Paper – V : (b) Biology For Chemists

(For students without Biology in B.Sc.)

Unit – I	**Cell Structure and Functions** Structure prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP - the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to bio-molecules, building blocks of bio-macromolecules.
Unit – II	**Carbohydrates** Conformation of monosaccharides, structure and functions of important derivatives of mono-saccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoporteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid.
Unit – III	**Lipid** Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Liproproteins-composition and 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.
Unit – IV	**Amino-acids, Peptides and Proteins** Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. Force responsible for holding of secondary structures. 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, racemization /detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH).
Unit –V	**Nucleic Acids** Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of

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	nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

Books suggested :

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

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M. Sc. CHEMISTRY PRACTICALS (SEMESTER – I)

Practical examination shall be conducted separately for each branch : (Duration : 6-8 hrs in each branch).

Inorganic Chemistry

Qualitative & Quantitative Analysis		12
Chromatography		06
Preparation		06
Record		04
Viva Voce		05
	Total :	33

Qualitative Analysis :

(a) Analysis of Less common metal ions : W, Mo, Se, Ti, Zr, Ce, V, etc. (Two metal ion in cationic / anionic forms).

(b) Analysis of Insoluble residue : Oxides, sulphates & halides.

Quantitative Analysis : Separation & estimation of two metal ions viz., Cu – Zn, Fe – Mg, Ni – Zn, etc. involving volumetric & gravimetric methods.

Chromatography: Separation, identification & determination of cations & anions by Paper Chromatography.

Preparations : Preparation of selected inorganic complexes, their analysis, test & characterization by spectral techniques (may be).

(1) $VO(acac)_2$.

(2) $Ni(acac)_2$.

(3) $[Co(NH_3)_6]Cl_3$.

(4) $NH_4[Cr(NH_3)_2(SCN)_4]$ … Reinecke's salt.

(5) Prussian Blue ; Turnbull's Blue.

(6) Oxalate complexes of Chromium (III) & Copper (II).

Organic Chemistry

Qualitative Analysis	12
Organic Synthesis	12
Record	04
Viva-Voce	05
Total :	33

Qualitative Analysis : Separation, purification & identification of compounds of ternary mixture (solid or solid + liquid) using TLC & columns chromatography, chemical tests. IR spectra to be used for functional group identification.

Organic Synthesis :
Acetylation, Nitration, Halogenation, Oxidation, Reduction, Polymerization.

Physical Chemistry

Any **one** Experiment / Exercise from **Section – A**	12
Any **one** Experiment / Exercise from **Section – B**	13
Record	04
Viva-Voce	05
Total :	34

Section – A

Error Analysis & Statistical Data Analysis
Errors, types of errors, minimization of errors distribution curves precision, accuracy & combination; statistical treatment for error analysis, student's t-test, null hypothesis, rejection criteria. F & Q – test; linear regression analysis, curve fitting. Calibration of volumetric apparatus : Burette, pipette & standard flask.

Adsorption : To study surface tension – concentration relationship for solutions (Gibb's equation).

Phase Equilibria :

(i) Determination of congruent composition & temperature of a 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 – water).

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Section – B

Chemical Kinetics :

(i) Determination of the effect of (a) Change of temperature (b) Change of concentration of reactant & catalyst & (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester / ionic reaction.

(ii) Determination of the velocity constant of hydrolysis of an ester / ionic reaction in micellar media.

(iii) Determination of the velocity constant for the oxidation of iodide ions by hydrogen peroxide. Study the kinetics as an iodine clock reaction.

(iv) Flowing clock reactions (Ref : Experiments in Physical Chemistry by Showmaker).

(v) Determination of the primary salt effect on the kinetics of ionic reaction & testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion).

Solution:

(i) Determination of molecular weight of non – volatile & electrolyte / electrolyte by cryoscopic method & to determine the activity coefficient of an electrolyte.

(ii) Determination of the degree of dissociation of weak electrolyte & to study the deviation from ideal behavior that occurs with a strong electrolyte.

Books Suggested

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly. Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.
5. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
6. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
9. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
10. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

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M.Sc. CHEMISTRY (SEMESTER – II)

Paper No. : I (Code-MCH-406)
Compulsory /Optional : Compulsory
Max. Marks : 100

Paper – I : Inorganic Chemistry

Unit – I	**Electronic Spectral Studies of Transition Metal Complexes :** Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), Selection rule for electronic spectroscopy. Intensity of various type electronic transitions. Calculations of 10Dq, B and β parameters, charge transfer spectra.
Unit – II	**Magnetic Properties of Transition Metal Complexes** Anomalous magnetic moments, Quenching of Orbital contribution. Orbital contribution to magnetic moment, magnetic exchange coupling and spin crossover.
Unit – III	**Metal π-Complexes** Metal carbonyl, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reaction of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.
Unit – IV	**Metal-Clusters** Higher boranes, carboranes, metalloboranes and metallo-carboranes compounds with metal-metal multiple bonds.
Unit –V	**Optical Rotatory Dispersion and Circular Dichroism** Linearly and circularly polarized lights; optical rotatory power and circular birefringence, elipticity and circular dichroism; ORD and Çotton effect, Faraday and Kerr effects; Assignment of electronic transitions; applications of ORD and CD for the determination of (i) absolute configuration of complexes and (ii) isomerism due to non-planarity of chelate rings.

Books Suggested :

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huheey, Harpes & Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetiochemistry, R.1. Carlin, Springer Verlag.
6. Comprehensive Coordiantion Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. Mc Cleverty, Pergamon.

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M.Sc. CHEMISTRY (SEMESTER – II)

Paper No. : II (Code-MCH-407)
Compulsory /Optional : Compulsory
Max. Marks : 100

Paper – II : Organic Chemistry

Unit – I	**Aromatic Electrophilic Substitution** The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction. **Aromatic Nucleophilic Substitution** The SNAr SN^1, benzyne and SN^1 mechanism, Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet-Hauser, and Smiles rearrangements.
Unit – II	**Free Radical Reactions** Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.
Unit – III	**Addition Reactions** Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemo-selectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation.
Unit – IV	**Addition to Carbon-Hetero Multiple bonds** Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters. **Elimination Reactions** The E_2, E_1 and E_1cB mechanisms and their spectrum. Orientation of the double bond. Reactivity-effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

	Pericyclic Reactions Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of periycyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n 4n+2 and allyl systems. Cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotrpic reactions. Sigmatropic rearrangements-suprafacial and antarafacial shifts of H, sigmatropic involving carbon moieties, 3,3- and 5,5-sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.

Books Suggested :

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

M.R.S.C.P.S. INDORE

DEVI AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. CHEMISTRY (SEMESTER – II)

Paper No. : III (Code- MCH-408)
Compulsory /Optional : Compulsory
Max. Marks : 100

Paper – III : Physical Chemistry

Unit – I	**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 homogenous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel- Marcus (RRKM) theories for unimolecular reactions).
Unit – II	**Surface Chemistry** **Adsorption** Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon). **Micelles** Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles.
Unit – III	**Macromolecules** Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods, sedimentation), chain configuration of macromolecules, calculation of average dimension of various chain structures.
Unit – IV	**Non-Equilibrium Thermodynamics** Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electrokinetic phenomena, diffusion, electric conduction.

Electrochemistry

Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance.

Books Suggested :

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

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M.Sc. CHEMISTRY (SEMESTER – II)

Paper No. : IV (Code- MCH - 409)
Compulsory /Optional : Compulsory
Max. Marks : 100

Paper – IV : Spectroscopy II & Diffraction Methods

Unit – I	**Nuclear Magnetic Resonance Spectroscopy** Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant "j" Classification (AXB, AMX, ABC, A_2B_2 etc.). Spin decoupling; basic ideas about instrument, NMR studies of nuclei other than proton-^{13}C, ^{19}F and ^{31}P. FT NMR, advantages of FT NMR.
Unit – II	**Nuclear Quadrupole Resonance Spectroscopy** Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splitting. Applications.
Unit – III	**Electron Spin Resonance Spectroscopy** Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications.
Unit – IV	**X-ray Diffraction** Bragg condition, Miller indices, Laue Method, Bragg method, Debye Scherer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern, Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules.
Unit –V	**Electron Diffraction** Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces. **Neutron Diffraction** Scattering of neutrons by solids measurement techniques, Elucidation of structure of magnetically ordered unit cells.

Books suggested:

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

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M.Sc. CHEMISTRY (SEMESTER – II)

Paper No. : **V (Code- MCH - 410)**
Compulsory /Optional : **Compulsory**
Max. Marks : **100**

Paper – V : Computers For Chemists

This is a theory cum-laboratory co use with more emphasis on laboratory work.

Unit – I	**Introduction to computers and Computing** Basic structure and functioning of computer with a PC as illustrative example. Memory I/O devices. Secondary storage Computer languages. Operating systems with DOS as an example Introduction to UNIX and WINDOWS. Principles of programming Algorithms and flow-charts.
Unit – II	**Computer Programming in FORTRAN/C/BASIC** (The language features are listed here with reference to FORTRAN. The instructor may choose another language such as BASIC or C the features may be replaced appropriately). Elements of the compute language. Constants and variables. Operations and symbols Expressions. Arithmetic assignment statement. Input and output Format statement. Termination statements. Branching statements as IF or GO TO statement. LOGICAL variables. Double precession variables. Subscripted variables and DIMENSION. DO statement FUNCTION AND SUBROUTINE. COMMON and DATA statement (Student learns the programming logic and these language feature by hands on experience on a personal computer from the beginning of this topic.)
Unit – III	**Programming in Chemistry** Developing of small computer codes using any one of the languages FORTRAN/C/BASIC involving simple formulae in Chemistry, such as Vander Waals equation. Chemical kinetics (determination of Rate constant) Radioactive decay (Half Life and Average Life). Determination Normality, Molarity and Molality of solutions. Evaluation Electronegativity of atom and Lattice Energy from experimental determination of molecular weight and percentage of element organic compounds using data from experimental metal representation of molecules in terms of elementary structural features such as bond lengths, bond angles.
Unit – IV	**Use of Computer Programmes** Operation of PC. Data Processing. Running of standard Programs and Packages such as MS WORD, MS EXCEL -special emphasis on calculations and chart formations. X-Y plot. Simpson's Numerical Integration method. Programmes with data preferably from physical chemistry laboratory.
Unit –V	**Internet** Application of Internet for Chemistry with search engines, various types of files like PDF, JPG, RTF and Bitmap. Scanning, OMR, Web camera.

Books suggested:

1. Fundamentals of Computer : V. Rajaraman (Prentice Hall)
2. Computers in Chemistry : K.V. Raman (Tata Mc Graw Hill)
3. Computer Programming in FORTRAN IV-V Rajaraman (Prentice Hall)

DEVI AHILYA VISHWAVIDYALAYA, INDORE
M. Sc. CHEMISTRY PRACTICALS (SEMESTER – II)

Practical examination shall be conducted separately for each branch : (Duration : 6-8 hrs in each branch).

Inorganic Chemistry

Chromatography	12
Preparations	12
Record	04
Viva-Voce	05
Total :	33

Chromatography : Separation, identification & determination of cations & anions by Column Chromatography : Ion exchange.

Preparations : Preparation of selected inorganic complexes, their analysis, test & characterization by spectral techniques (may be).

(1) $K_3[Cr(SCN)_6].4H_2O$.
(2) $[Co(NH_3)_4(NO_2)_2]Cl$.
(3) $[Co(NH_3)_5Cl]Cl_2$.
(4) $Ni(dmg)_2$.
(5) $[Co(py)_2Cl_2]$.
(6) $[Cu.3[CS(NH_2)]_2SO_4.2H_2O$.
(7) $Na_3[Co(NO_2)_6]$.

Organic Chemistry

Organic Synthesis	12
Quantitative Analysis	12
Record	04
Viva-Voce	05
Total :	33

Organic Synthesis :

(A) Synthesis involving name reactions :

(i) Sandmeyer's reaction.
(ii) Cannizaro's reaction.
(iii) Diel's Alder reaction.
(iv) Knoevenagel reaction.

(B) Synthesis of Dyes :

(i) Phenolphthalein, (ii) Fluorescein, (iii) Diazotization followed by coupling.

Quantitative Estimations :

1. Determination of the percentage or number of hydroxyl groups in an organic compound by Acetylation method.
2. Estimation of amines / phenols using Bromate – Bromide solution or Acetylation method.
3. Saponification value, iodine value & acid values of an oil or fat.

Physical Chemistry

Any one Experiment / Exercise from Section – A	12
Any one Experiment / Exercise from Section – B	13
Record	04
Viva-Voce	05
Total :	34

Section – A

Conductometry

(i) Determination of the velocity constant, order of the reaction & energy activation for saponification of ethyl acetate by sodium hydroxide conducotmetrically.

(ii) Determination of solubility & solubility product of sparingly soluble salts (e.g., $PbSO_4$. $BaSO_4$) conductometrically.

(iii) Determination of the strength of strong & weak acid in a given mixture conductometrically.

(iv) To study the effect of solvent on the conductance of $AgNO_3$ / acetic acid & to determine the degree of dissociation & equilibrium constant in different solvents & in their mixtures (DMSO, DMF, dioxane, acetone, water) & to test the validity of Debye – Huckel – Onsager theory.

(v) Determination of the activity coefficient of zinc ions in the solution of 0.002M zinc sulphate using Debye Huckel's limiting law.

Polarimetry

(i) Determination of rate constant for hydrolysis / inversion of sugar using a polarimeter.

(ii) Enzyme kinetics – inversion of sucrose.

Section – B

Potentiometry / pH metry

1. Determination of strengths of halides in a mixture potentiometrically.
2. Determination of the strengths of strong & weak acids in a given mixture using a Potentiometer / pH-meter.
3. Determination of temperature dependence of EMF of a cell.
4. Determination of the formation constant of silver – ammonia complex & stoichiometry of the complex Potentiometrically.
5. Acid – base titration in a non – aqueous media using a pH-meter.

Refractometry

Determination of Refractive indices & specific refractions, Molar & atomic refractivities, composition of a mixture of liquids, concentration of sugar in a solution & polarizabilities of liquids.

Books suggested

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly. Prentice Hall.
3. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
4. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.
5. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
6. Handbook of Organic Analysis-qualitative and Quantitative, H. Clark, Adward Arnold.
7. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
8. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
9. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
10. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

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M.R.S.C.P.S. INDORE

Scheme and Syllabus
of
M.Sc. Chemistry

III and IV Semesters
Effective from Academic Year 2016-17 onwards

Devi Ahilya Vishwavidyalaya,
Indore (M.P.), 452001

DEVI AHILYA VISHWAVIDYALAYA, INDORE

Scheme of Marks

M. Sc. Chemistry

(w.e.f. 2016 and onwards)

SEMESTER – III

Paper	Compulsory/Optional	Paper Title	Code (MCH)	Max. Marks
I	Compulsory	APPLICATION OF SPECTROSCOPY-I	501	85+ 15(CCE) = 100
II	Compulsory	PHOTOCHEMISTRY	502	85+ 15(CCE) = 100
III	Compulsory	ENVIRONMENTAL CHEMISTRY	503	85+ 15(CCE) = 100
IV	Optional -I	ANY TWO	504-508	85+ 15(CCE) = 100
V	Optional -II			85+ 15(CCE) = 100
		PRACTICAL-1. Inorganic 2. Organic 3. Physical		33 33 34 =100
		Total		600

SEMESTER – IV

Paper	Compulsory/Optional	Paper Title	Code (MCH)	Max. Marks
I	Compulsory	APPLICATION OF SPECTROSCOPY-II	511	85+ 15(CCE) = 100
II	Compulsory	SOLID STATE CHEMISTRY	512	85+ 15(CCE) = 100
III	Compulsory	BIOCHEMISTRY	513	85+ 15(CCE) = 100
IV	Optional	ANY TWO	514-518	85+ 15(CCE) = 100
V	Optional			85+ 15(CCE) = 100
		PRACTICAL- 1. Inorganic 2. Organic 3. Physical		33 33 34 =100
		Project Work – Duration	60 HOURS	100
		Total		700

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DEVI AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. CHEMISTRY (SEMESTER –III)

Paper No. : I (Code-MCH-501)
Compulsory / Optional : Compulsory
Max. Marks : 100

PAPER I : APPLICATION OF SPECTROSCOPY-I

Unit - 1	**Electronic Spectroscopy:** Electronic Spectral Studies for d^1 - d^9 systems in octahedral, tetrahedral and square planer complexes
Unit - 2	**Vibrational Spectroscopy** Symmetry and shapes of AB_2, AB_3, AB_4, AB_5 and AB_6, mode of bonding of ambidentate ligands, nitrosyl, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy and its applications.
Unit - 3	**Nuclear Magnetic Resonance Spectroscopy-I** General introduction and definition, chemical shift, spin-spin interaction, shielding and deshielding mechanism, mechanism of measurement of chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto),
Unit - 4	**Nuclear Magnetic Resonance Spectroscopy-II** Chemical exchange, effect of deuteration, Complex spin spin interaction between two, three, four and five nuclei (I order spectra) Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with disordered angle. NMR shift reagents, solvent effects. nuclear overhauser effect (NOE).
Unit - 5	**Mössbauer Spectroscopy** Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (2) Sn^{+2} and Sn^{+4} compounds nature of M-L bond, coordination number, structure and (3) detection of oxidation state and inequivalent MB atoms.

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

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DEVI AHILYA VISHWAVIDYALAYA, INDORE
M.Sc. CHEMISTRY (SEMESTER –III)

Paper No : II (Code-MCH-502)
Compulsory Optuonal : Compulsory
Max. Marks : 100

PAPER II : PHOTOCHEMISTRY

Unit-1	**Photochemical Reactions** Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.
Unit-2	**Determination of Reaction Mechanism** Classification, rate constants and life times of reactive energy state, determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis.
Unit-3	**Photochemistry of Alkenes** Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes. **Photochemistry of Aromatic Compounds** Isomerisations, additions and substitutions.
Unit-4	**Photochemistry of Carbonyl Compounds** Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β, ϒ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cyloaddition reactions-dimerisations and oxetane formation.
Unit-5	**Miscellaneous Photochemical Reactions** Photo-Fries reactions of annilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen and its reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.

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Fundamentals of photochemistry, K.K. Rothagi-Mukheriji, Wiley-Eastern.
Essentials of Molecular Photochemistry, A Gilbert and J. Baggott, Blackwell Scientific Publication.
3. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
4. Introductory Photochemistry, A. Cox and T. Camp, McGraw Hill.
5. Photochemistry, R.P. Kundall and A. Gilbert. Thomson Nelson.
6. Organic Photochemistry, J. Coxon and B.Halton, Cambridge University Press.

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CHEMISTRY (SEMESTER –III)

: I (Code-MCH-503)
: Compulsory
: 100

PAPER III: ENVIRONMENTAL CHEMISTRY

Unit-1	**Atmosphere** Atmospheric layers, Vertical temperature profile, heat/radiation budget of the earth atmosphere systems. Properties of troposphere, thermodynamic derivation of lapse rate. Temperature inversion. Calculation of Global mean temperature of the atmosphere. Pressure variation in atmosphere and scale height. Biogeochemical cycles of carbon, nitrogen, sulphur, phosphorus, oxygen. Residence times. **Atmospheric Chemistry** Sources of trace atmospheric constituents : nitrogen oxides, sulphurdioxide and other sulphur compounds, carbon oxides, chlorofluorocarbons and other halogen compounds, methane and other hydrocarbons. **Tropospheric Photochemistry** Mechanism of Photochemical decomposition of NO_2 and formation of ozone. Formation of oxygen atoms, hydroxyl, hydroperoxy and organic radicals and hydrogen peroxide. Reactions of hydroxyl radicals with methane and other organic compounds. Reaction of OH radicals with SO_2 and NO_2. Formation of Nitrate radical and its reactions. Photochemical smog meteorological conditions and chemistry of its formation.
Unit-2	**Air Pollution** Air pollutants and their classifications. Aerosols-sources, size distribution and effect on visibility, climate and health. **Acid Rain** Definition, Acid rain precursors and their aqueous and gas phase atmospheric oxidation reactions. Damaging effects on aquatic life, plants, buildings and health. Monitoring of SO_2 and NO_2. Acid rain control strategies. **Stratospheric Ozone Depletion** Mechanism of Ozone formation, Mechanism of catalytic ozone depletion, Discovery of Antarctic Ozone hole and Role of chemistry and meteorology. Control Strategies. **Green House Effect** Terrestrial and solar radiation Spectra, Major green house gases and their sources and Global warming potentials. Climate change and consequences. **Urban Air Pollution** Exhaust emissions, damaging effects of carbon monoxide. Monitoring of CO. Control strategies.
Unit-3	**Aquatic Chemistry and Water Pollution** Redox chemistry in natural waters. Dissolved oxygen, biological oxygen demand, chemical oxygen demand, determination of DO, BOD and COD. Aerobic and anaerobic reactions of organic sulphur and nitrogen compounds in water acid-base chemistry of fresh water and sea water. Aluminum, nitrate and fluoride in water. Petrification. Sources of water pollution. Treatment of waste and sewage. Purification of drinking water, techniques of purification and disinfection.
Unit-4	**Environmental Toxicology** **Toxic heavy metals :** Mercury, lead, arsenic and cadmium. Causes of toxicity. Bioaccumulation, sources of heavy metals. Chemical speciation of Hg, Pb, As, and Cd. Biochemical and damaging effects.

	Toxic Organic Compound : Pesticides, classification, properties and uses of organochlorine and ionospheres pesticides detection and damaging effects. **Polychlorinated biphenyls :** Properties, use and environmental continuation and effects. **Polynuclear Aromatic Hydrocarbons :** Source, structures and as pollutants.
Unit-5	**Soil and Environmental Disasters** Soil composition, micro and macronutrients, soil pollution by fertilizers, plastic an metals. Methods of re-mediation of soil. Bhopal gas tragedy, Chernobyl, three mile island, Minimtata Disease, Sevoso (Italy), London smog.

Books Suggested:

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

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OPTIONAL PAPERS

Out of the following select any two papers:

OPT-1	MCH-504	Organotransition Metal Chemistry
OPT-2	MCH-505	Polymers
OPT-3	MCH-506	Heterocyclic Chemistry
OPT-4	MCH-507	Physical Organic Chemistry
OPT-5	MCH-508	Chemistry of Materials

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M.Sc. CHEMISTRY (SEMESTER –III)

Paper No. : OPT-1 Code- MCH-504
Compulsory/ Optional : Optional
Max. Marks : 100

Optional Paper : Organotransition Metal Chemistry

Unit-1	**Alkyls and Aryls of Transition Metals** Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis. **Compounds of Transition Metal-Carbon Multiple Bonds** Alkylidenes, alkylidynes, low valent carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis.
Unit-2	**Transition Metal π-Complexes** Transition metal π-Complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparation, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.
Unit-3	**Transition organometalic compounds**: Transition metal compounds with bonds to hydrogen, boron, silicon
Unit-4	**Homogeneous Catalysis** Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxoreaction), explanation reactions, activation of C-H bond.
Unit-5	**Fluxional Organometallic Compounds** Flexionality and dynamic equilibrium in compounds such as η^2 olefine, η^3-allyl and dienyl complexes.

Books Suggested :

1. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree. John Wiley.
3. Metallo-organic Chemistry, A.J. Pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh New Age International.

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M.Sc. CHEMISTRY (SEMESTER –III)

Paper No. : **OPT-2 Code- MCH-505**
Compulsory / Optional : **Optional**
Max. Marks : **100**

Optional Paper : Polymers

Unit-1	**Basics** Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition/radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.
Unit-2	**Polymer Characterization** Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity an molecular weight distribution. The practical significance of molecular weight. Measurement of molecular-weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods.
Unit-3	**Analysis and testing of polymers** Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. fatigue, impact, tear resistance, Hardness and abrasion resistance.
Unit-4	**Inorganic Polymers** A general survey and scope of Inorganic Polymers special characteristics, classification, homo and hetero atomic polymers. Structure, Properties and Applications of a. Polymers based on boron-borazines, boranes and carboranes. b. Polymers based on Silicon, silicone's polymetalloxanes and polymetallosiloxanes, silazanes.
Unit-5	**Structure, Properties and Application of Polymers** a. Polymers based on Phosphorous-Phosphazenes, Polyphosphates b. Polymers based on Sulphur-Tetrasulphur tetranitride and related compounds. c. Co-ordination and metal chelate polymers.

Books Suggested:

1. Inorganic Chemistry, J.E. Huheey, Harper Row.
2. Developments in Inorganic polymer Chemistry, M.F. Lappert and G.J. Leigh.
3. Inorganic polymers- N.H. Ray.
4. Inorganic polymers, Graham and Stone.
5. Inorganic Rings and Cages : D.A. Armitage.
6. Textbook of Polymers Science, F.W. Billmeyer Jr. Wiley.
7. Contemporary Polymer Chemistry, H.R. Al cock and F.W. Lambe, Prentice Hall.

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M.R.S.C.P.S. INDORE

DEVI AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. CHEMISTRY (SEMESTER –III)

Paper No. : **OPT-3 Code- MCH-506**
Compulsory / Optional : **Optional**
Max. Marks : **100**

Optional Paper : Heterocyclic Chemistry

Unit-1	**Nomenclature of Heterocycles** Replacement and systematic nomenclature (HantzsMCH-Widman system) for monocyclic fused and bridged heterocycles. **Aromatic Heterocycles** General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in 1H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.
Unit-2	**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. Atereo-electronic effects anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions. Heterocyclic synthesis-prineples of heterocyclic synthesis involing cyclization reactions and cycloaddition reactions.
Unit-3	**Small Ring Heterocycles** Three-membered and four-membered heterocycles-synthesis and reactions of azirodines, oxiranes, thiranes, azetidines, oxetanes and thietanes. **Benzo-Fused Five-Membered Heterocycles** Synthesis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes.
Unit-4	**Meso-ionic Heterocycles** General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications. **Six-Membered Heterocycles with one Heteroatom** Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and phridones. Synthesis and reactions of quionlizinium and benzopyrylium salts, coumarins and chromones.
Unit-5	Six Membered Heterocycles with Two or More Heteroatoms: Synthesis and reactions of diazones, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles: Synthesis and reactions of azepines, oxepines, thiepines, diazepines, thiazepines, azocines, diazocines, dioxocines and dithiocines. **Heterocyclic Systems Containing P, As, Sb and B** Heterocyclic rings containing phosphorus : Introduction, nomenclature, synthesis and characteristics of 5- and 6-membered ring systemsphosphorinaes, phosphorines, phospholanes and phospholes. Heterocyclic rings containing As and Sb : Introduction, synthesis and characteristics of 5- and 6-membered ring system. Heterocyclic rings containing B : Introduction, synthesis reactivity and spectral characteristics of 3- 5- and 6-membered ring system.

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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. Joule, K. Mills and g.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scietific Techinal.
5. Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introductiion to the Heterocyclic Compounds, R.M. Acheson, Johnwiely.
7. Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press.

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DEVI AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. CHEMISTRY (SEMESTER –III)

Paper No. : **OPT-4 Code- MCH-507**
Compulsory / Optional : **Optional**
Max. Marks : **100**

Optional Paper : Physical Organic Chemistry

Unit-1	**Concepts in Molecular Orbital (MO) and Valence Bond (VB) Theory** Introduction to Huckel molecular orbital (MO) method as a mean to explain modern theoretical methods. Advanced techniques in PMO and FMO theory. Molecular mechanics, semi empirical methods and ab initio and density functional methods. Scope and limitations of several computational programmes.
Unit-2	Quantitative MO theory : Huckel molecular orbital (HMO - method as applied to ethene, allyl and butadiene. Qualitative MO theory ionisation potential. Electron affinities. MO energy levels. Orbital symmetry. Orbital interaction diagrams. MO of simple organic systems such as ethene, allyl, butadiene, methane and methyl group. Conjugation and hyper-conjugation. Aromaticity. Valence bond (B) configuration mixing diagrams. Relationship between VB configuration mixing and resonance theory. Reaction profiles. Potential energy diagrams. Curve-crossing model-nature of activation barrier in chemical reactions.
Unit-3	**Principles of Reactivity** Mechanistic significance of entropy, enthalpy and Gibb's free energy. Arrrhenius equation. Transition state theory. Uses of activation parameters, Hammond's postulate, Bell-Evans-Polanyi Principle. Potential energy surface model. Marcus theory of electron transfer. Reactivity and selectivity principles. **Kinetic Isotope Effect** Theory of isotope effects. Primary and secondary kinetic isotope effects. Heavy atom isotope effects. Tunneling effect. Solvent effects. **Structural Effects on Reactivity** Linear free energy relationships (LFER). The Hammett equation, substituent constants, theories of substituent effects. Interpretation of δ-values. Reaction constants. Deviations from Hammett equation. Dualparameter correlatins, inductive substituent constant. The Taft model, s1 and sR scales.
Unit-4	**Acids, Bases, Electrophiles, Nucleophiles and Catalysis** Acid-base dissociation, Electronic and structural effects, acidity and basicity. Acidity functions and their applicatins. hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The α-effect. Ambivalent nucleophiles. Acid-base catalysis-specific and general catalysis. Bronsted catalysis, Nucleophilic and electrophilic catalysis. Catalysis by noncovalent binding-micellar catalysis. **Steric and Conformation Properties** Various type of steric strain and their influence on reactivity. Steric acceleration. Molecular measurements of steric effects upon rates. Steric LFET, Conformational barrier to bond rotation-spectroscopic detection of individual conformers. Acyclic and monocyclic systems. Rotation around partial double bonds. Winstein-Holness and Curtin-Hammett principle.

ectrophilic Reactivity

electronic effects on SN^1 and SN^2 reactivity. Solvent effect, Kinetic isotope intramolecular assistance. Electron transfer nature of SN^2 reaction. Nucleophilicity SN^2 reactivity based on curved crossing mode. Relationship between polar and electron transfer reactions, $SR_N{}^1$ mechanism. Electrophilic reactivity, general mechanism. Kinetic of $S_E{}^2$ Ar reaction. Structural effects on rates and selectivity. Curve-crossing approach to electrophilic reactivity.

Supramolecular Chemistry

Properties of covalent bonds-bond length, inter-bond angles, force constant, bond and molecular dipole moments. Molecular and bond polarizability, bond dissociation enthalpy, entropy. intermolecular forces, hydrophobic effects. Electrostatic, induction, dispersion and resonance energy, magnetic interactions, magnitude of interaction energy, forces between macroscopic bodies, medium effects. Hydrogen bond.

Books Suggested :

1. Molecular Mechanics, U. Burket and N.L. Allinger, ACS Monograph 177, 1982.
2. Orgaic Chemists, Book of Orbitals : L. Salem and W.L. Jorgensen, Academic Press.
3. Mechanism and Theory in Organic chemistry, T.H. Lowry and K.C. Richadson, Harper and Row.
4. Introduction to Theoretical Organic Chemistry and Molecular Modeling.
5. Physical Organic Chemistry : N.S. Isaacs, ELBS/Longman.
6. Supramolecular Chemistry : Concepts and Perspective, J.M. Lehn, VCH.
7. The Physical Basis of Organic Chemistry : H. Maskill, Oxford University Press.

M.R.S.C.P.S. INDORE

AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. CHEMISTRY (SEMESTER –III)

sory / Optional : OPT-5 Code- MCH-508

xx. Marks : Optional

: 100

Optional Paper : Chemistry of Materials

Unit-1	**A. Multiphase materials** Ferrous alloys; Fe-C phase transformations in ferrous alloys; stainless steels, non ferrous alloys, properties of ferrous and non-ferrous alloys and their applications. **B. Glasses, Ceramics, Composites and Nanomaterials** Glassy state, glass formers and glass modifiers, applications. Ceramic structures, mechanical properties, clay products. Refractories, characterizations, properties and applications. Microscopic composites; dispersion-strengthened and particle-reinforced, firbre-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, special properties, applications.
Unit-2	**A. Thin Films and Langmuir-Blodgett Films** Preparation techniques; evaporation/sputtering, chemical processes, MOCVD, sol-gel etc. Languir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films. **B Liquid Crystals** Mesmorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic-nematic transition and clearing temperature-homeotropic, planer and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.
Unit-3	**A. Polymeric Materials** Molecuar shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their applications, conducting and ferro-electric polymers. **B. Ionic Conductors** Types of ionic conductgors, mechanism of ionic conduction, interstitial jumps (Frenkil); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors.
Unit-4	**High T_c Materials** Defect perovskites, high T_c superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high T_c materials, applications of high T_c materials.
Unit-5	**A. Materials of Solid State Devices** Rectifiers, transistors, capacitors-IV-V compounds, low-dimentional quantum structures, optical properties. **B. Organic Solids, Fullerenes, Muleuclar Devices** Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes-doped, fullerenes as superconductors. Moleuclar rectifiers and transistors, artificial phytosynthetic devices, optical storage memory and switches-sensors. Nonlinear optical materials; nonlinear optical effects, second and third order-molecular hyperpolarisability an second order electric susceptibility – materials for second and third harmonic generation.

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	ectrophilic Reactivity electronic effects on SN^1 and SN^2 reactivity. Solvent effect, Kinetic isotope intramolecular assistance. Electron transfer nature of SN^2 reaction. Nucleophilicity SN^2 reactivity based on curved crossing mode. Relationship between polar and electron transfer reactions, $SR_N{}^1$ mechanism. Electrophilic reactivity, general mechanism. Kinetic of $S_E{}^2$ Ar reaction. Structural effects on rates and selectivity. Curve-crossing approach to electrophilic reactivity. **Supramolecular Chemistry** Properties of covalent bonds-bond length, inter-bond angles, force constant, bond and molecular dipole moments. Molecular and bond polarizability, bond dissociation enthalpy, entropy. intermolecular forces, hydrophobic effects. Electrostatic, induction, dispersion and resonance energy, magnetic interactions, magnitude of interaction energy, forces between macroscopic bodies, medium effects. Hydrogen bond.

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1. Molecular Mechanics, U. Burket and N.L. Allinger, ACS Monograph 177, 1982.
2. Orgaic Chemists, Book of Orbitals : L. Salem and W.L. Jorgensen, Academic Press.
3. Mechanism and Theory in Organic chemistry, T.H. Lowry and K.C. Richadson, Harper and Row.
4. Introduction to Theoretical Organic Chemistry and Molecular Modeling.
5. Physical Organic Chemistry : N.S. Isaacs, ELBS/Longman.
6. Supramolecular Chemistry : Concepts and Perspective, J.M. Lehn, VCH.
7. The Physical Basis of Organic Chemistry : H. Maskill, Oxford University Press.

AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. CHEMISTRY (SEMESTER –III)

istry / Optional : OPT-5 Code- MCH-508
: Optional
ax. Marks : 100

Optional Paper : Chemistry of Materials

Unit-1	**A. Multiphase materials** Ferrous alloys; Fe-C phase transformations in ferrous alloys; stainless steels, non ferrous alloys, properties of ferrous and non-ferrous alloys and their applications. **B. Glasses, Ceramics, Composites and Nanomaterials** Glassy state, glass formers and glass modifiers, applications. Ceramic structures, mechanical properties, clay products. Refractories, characterizations, properties and applications. Microscopic composites; dispersion-strengthened and particle-reinforced, firbre-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, special properties, applications.
Unit-2	**A. Thin Films and Langmuir-Blodgett Films** Preparation techniques; evaporation/sputtering, chemical processes, MOCVD, sol-gel etc. Languir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films. **B Liquid Crystals** Mesmorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic-nematic transition and clearing temperature-homeotropic, planer and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.
Unit-3	**A. Polymeric Materials** Molecuar shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their applications, conducting and ferro-electric polymers. **B. Ionic Conductors** Types of ionic conductgors, mechanism of ionic conduction, interstitial jumps (Frenkil); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors.
Unit-4	**High T_c Materials** Defect perovskites, high T_c superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high T_c materials, applications of high T_c materials.
Unit-5	**A. Materials of Solid State Devices** Rectifiers, transistors, capacitors-IV-V compounds, low-dimentional quantum structures; optical properties. **B. Organic Solids, Fullerenes, Muleuclar Devices** Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes-doped, fullerenes as superconductors. Molecular rectifiers and transistors, artificial phytosynthetic devices, optical storage memory and switches-sensors. Nonlinear optical materials; nonlinear optical effects, second and third order-molecular hyperpolarisability an second order electric susceptibility – materials for second and third harmonic generation.

ded:

1. Solid State Physics, N.W.Ashcroft and N.D.Mermin, Saunders College.
2. Materials Science and Engineering, An Introduction, W.D.Callister, Wiley.
3. Principles of the Solid State, H.V. Keer, Wiley Eastern.
4. Materials Sciences, J.C.Anderson, K.D.Leaver, J.M.Alexander and R.D. Rawlings, ELBS
5. Thermotropic liquid Crystals, Edl, G.W. Gray, John Wiley.
6. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.

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M.R.S.C.P.S. INDORE

...T AHILYA VISHWAVIDYALAYA, INDORE
...Sc. CHEMISTRY PRACTICALS (SEMESTER – III)

...examination shall be conducted separately for each branch : (Duration : 6-8 hrs in ...h branch).

Inorganic Chemistry

Quantitative determination of a three component mixture	12
Chromatographic separations	12
Record	04
Viva-Voce	05
Total :	33

Quantitative determination of a three component mixture :
One Volumetrically & two gravimetrically
a. Cu^{2+}, Ni^{2+}, Zn^{2+}
b. Ag^{2+}, Ni^{2+}, Mg^{2+}

Chromatographic separations & determination of R_f values :
(Thin layer / Paper / Column chromatography)
(i) Group II metal ions.
(ii) Indicators.
(iii) Cu^{2+}, Fe^{3+}, Ni^{2+} & Co^{2+}.
(iv) Ink pigment.

Organic Chemistry

Multi – Step Synthesis of Organic compounds	12
Quantitative Estimations	12
Record	04
Viva-Voce	05
Total :	33

Multi – Step Synthesis of Organic compounds :
Exercise should illustrate the use of organic reagents & may involve purification of the products by chromatographic techniques :
Aniline → *p* – Nitroaniline; Aniline → *p* – Bromoaniline; Phthalic acid → Anthranilic acid; Pinacol Pinacolone rearrangement (Benzophenone → Benzopinacol → Benzopinacolone); Benzoin Benzilic acid (Benzoin → Benzil → Benzilic acid); Benzidine rearrangement (Hydrazobenzene → Benzidine).

Quantitative Estimations (Titrimetric method) :
(1) Estimation of glucose, glycine & ascorbic acid from Vitamin – C tablet.
(2) Determination of DO, COD & BOD of water sample.

Physical Chemistry

Any one Experiment / Exercise from **Section – A**	12
Any one Experiment / Exercise from **Section – B**	13
Record	04
Viva Voce	05
Total :	34

Section – A

Spectroscopy

1. (a) Interpretation of IR, NMR spectra.
   (b) Numerical problems on UV, IR & NMR.

2. **Spectrophotometry / Colorimetry**

(a) Determination of the composition of a mixture of $K_2Cr_2O_7$ & $KMnO_4$ by the application of mixture law.

(b) Determination of Phosphate concentration in a soft drink.

(c) Titration of Mohr's salt with $K_2Cr_2O_7$ / $KMnO_4$ solution.

(d) Determination of order & energy of activation for the decomposition of violet colour complex formed between ceric ions & N – Phenyl anthranilic acid.

Chemical Kinetics

1. Determination of kinetics of decomposition of complex formed between sodium sulphide & sodium nitroprusside spectrophotometrically.
2. Investigate the reaction between acetone & iodine.

Section – B

Electronics :

1. Study of the charge & discharge of a capacitor through a resistor.
2. Verification of Kirchoff's current law (KCL) & Kirchoff's voltage law (KVL).

Conductometry :

1. Determination of equivalent conductance of a weak electrolyte at different concentrations, and hence the dissociation constant of the electrolyte. Also verify Ostwald's dilution law.
2. Determination of equivalent conductance of a weak electrolyte at infinite dilution using Kohlrausch law.

pH metry:

1. Determination of Acidic and Basic dissociation constant of an amino acid and Isoelectric point of the acid.
2. Measurement of the pH of Buffer Solution ($CH_3COOH + CH_3COONa$) using Henderson's equation and hence pK_a.

Books Suggested:

1. Inorganic Experimens, J. Derek Woolings, VCH.
2. Microscale Inorganic Chemistry, Z. Szafran, R.M. Pike and M.M. Singh, Wiley.
3. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad.
4. The systematic Identification of Organic Compounds, R.L. Shriner and D.Y. Curlin.

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DEVI AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. CHEMISTRY (SEMESTER –IV)

Paper No. : I (Code-MCH-501)
Compulsory / Optional : Compulsory
Max Marks : 100

PAPER I: APPLICATION OF SPECTROSCOPY-II

Unit-1	**Ultraviolet and Visible spectroscopy** Various electronic transitions (185-800 nm) Beer-Lambert law, Effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls.
Unit-2	**Infrared Spectroscopy** Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance.
Unit –3	**Nuclear Magnetic Resonance of Paramagnetic Substances in Solution** The contact and Pseudo contact shifts, factors affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nuclide with emphasis on ^{31}P and ^{119}Sn NMR.
Unit-4	**Carbon-13 NMR Spectroscopy** General considerations, chemical shift (aliphatic olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOESY, DEPT, HMBC and HMQC techniques.
Unit-5	**Mass Spectrometry** Introduction ion production EI, CI, FD, ESI and FAB, factors affecting fragmentation, ion analysis, ion abundance Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Structure elucidation of simple molecules using UV – Visible, IR, NMR and mass spectral techniques.

Books Suggested:

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

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M.R.S.C.P.S. INDORE

DEVI AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. CHEMISTRY (SEMESTER –IV)

Paper No. : II (Code-MCH-512)
Compulsory / Optional : Compulsory
Max. Marks : 100

PAPER II: SOLID STATE CHEMISTRY

Unit-1	**Solid State Reactions** General principles, experimental procedure, co-precipitation as a precursory to solid state reactions, kinetics of solid state reactions.
Unit-2	**Crystal Defects and Non-Stoichiometry** Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky detects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry and defects.
Unit-3	**Electronic Properties and Band Theory** Metals insulators and semiconductors, electronic structure of solidsband theory band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties-Application of optical and electron microscopy. Magnetic Properties-Classification of materials : Effect of temperature calculation of magnetic moment, mechanism of ferro and anti ferromagnetic ordering super exchange.
Unit-4	**Organic Solids** Electrically conducting solids. organic charge transfer complex, organic metals, new superconductors.
Unit-5	**Liquid Crystals**: Types of liquid crystals: Nematic, Smectic, Ferroelectric, Antiferroelectric, Various theories of LC, Liquid crystal display, New materials.

Books Suggested:

1. Solid state chemistry and its applications, A.R. West. Peenum.
2. Principles of the Solid State, H.V. Keer, Wiley Eastern.
3. Solid State Chemistry, N.B. Hannay.
4. Solid State Chemistry, D.K. Chakrabarty, New Wiley Eastern.

DEVI AHILYA VISHWAVIDYALAYA, INDORE

M.Sc. CHEMISTRY (SEMESTER –IV)

Paper No. : III (Code-MCH-513)
Compulsory / Optional : Compulsory
Max. Marks : 100

PAPER III: BIOCHEMISTRY

Unit-1	**Metal Ions in Biological Systems** Bulk and trace metals with special reference to Na, K, Mg, Ca, Fe, Cu, Zn, Co, and K+/Na+ pump. **Bioenergetics and ATP Cycle.** DNA polymerisation, glucose storage, metal complexes in transmission of energy: chlorophyll's, photosystem I and photosystem II in cleavage of water. **Transport and Storage of Dioxygen** Heam proteins and oxygen uptake structure and function of haemoglobin's, mygolobin, haemocyanms and hemerythrin, model synthetic complexes of iron, cobalt and copper.
Unit-2	**Electron Transfer in Biology** Structure and function of metal of proteins in electron transport processes cytochrome's and ion-sulphure proteins, synthetic models. **Nitrogen fixation** Biological nitrogen fixation, and its mechanism, nitrogenase, Chemical nitrogen fixation.
Unit-3	**Enzymes** Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshalnd's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michael's-Menten and Lineweaver Burk plots, reversible and irreversible inhibition. **Mechanism of Enzyme Action** Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase. **Kinds of Reactions Catalysed by Enzymes** Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in Isomerisations reactions, b-Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.
Unit-4	**Co-Enzyme Chemistry** Cofactors as derived from vitamines, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors. **Enzyme Models** Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality Biometric chemistry, crown ether, cryptates. Cyclodextrins, cyclodextrion-based enzyme models, clixarenes, ionospheres, micelles synthetic enzymes or synzymes.

	Biotechnological Applications of Enzymes large-scale prodcution and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese-making, syrups from cron starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA Technology.
Unit-5	**Biological Cell and its Constituents** Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coils transition. **Bioenergetics** Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP. **Biopolymer Interactions** Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibrium and various types of bidning processes in biological systems. Hydrogen ion titration curves. **Cell Membrane and Transport of Ions** Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction.

Books Suggested :

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, 1. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Inorganic biochemistry vol. I and II ed. G.L. Eichhorn, Elsever.
4. Progress in Inorganic Chemistry, Vol 18 and 38 ed J.J. Lippard, Wiley.
5. Bioorganic Chemistry : A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
6. Understanding Enzymes, Trevor Palmer, Prentice Hall.
7. Enzyme Chemistry : Impact and applications, Ed. Collin J suckling, chemistry.
8. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
9. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
10. Immobilized Enzymes : An Introduction and Applications in Biotechnology, Michael ID. Trevan, Hohn Wiley.
11. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
12. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman
13. Biochemistry : The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.