



Eklavya University Damoh MP

M.Sc. Previous

Chemistry

Session 2020-21 onwards

School of Basic & Applied Science

EKLAVYA UNIVERSITY, DAMOH (M.P.)

Scheme of Examination M.Sc. (Chemistry) I Year (Previous)

/For batch admitted in Academic Session 2023-24/

Subject wise distribution of marks and corresponding credits

S. No.	Subject Name	Subject Code	Paper Name	Maximum Marks Allotted													Total Marks	Contact Periods Per week			Total Credits																																											
				Theory Slot					Practical Slot					Quiz/ Assignment/ Attendance	End Sem	Lab Work/ Sessional		L	T	P																																												
				Final Yearly	Half Yearly					Practical Slot																																																						
1	Common	MREMA20Y101	Research Methodology	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	5			50	4	4	8																																												
				60				15					30								10	100	4	4	4																																							
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2	Chemistry	MCHEM20Y104	Group Theory, Spectroscopy and Diffraction Methods (Paper - IV)	45				25					5			75	3		3																																													
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2	Chemistry	MCHEM20Y105	Mathematics For Chemists V (Optional- a1)	15				8					2			25	1		1																																													
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2	Chemistry	MCHEM20Y106	Biology For Chemists- 5B (Optional- a2)	15				8					2			25	1		1																																													
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2	Chemistry	MCHEM20Y107	Computer For Chemists- 5C (Optional- b)	15				8					2			25	1		1																																													
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2	Chemistry	MCHEM20Y108	Paper- I and Paper- II, Practical (Practical-I)	60				40					60			100	4		4																																													
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2	Chemistry	MCHEM20Y109	Paper- III, Practical	60				40					60			100	4		4																																													
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Induction programme of three weeks (MC): Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations.

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Class		M.Sc. Chemistry (Previous)	
Semester/Year		I Year	
Subject & Subject Code		Chemistry - MCHEM20Y101	
Paper		INORGANIC CHEMISTRY Paper- I	
Max. Marks		60	
Credit		Total Credits	
L	T	P	4
3	1	0	

Course Objectives:

On completion of the course, students are able to:

To learn about bonding in polyacids, inorganic polymers, formation, factors that affect stability of complexing stereo isomerism of inorganic complexes and crystal field theory and its limitations.

Course Outcome:

At the end of the course, learners will be able to:

1. To know the structure and bonding in molecules / ions and predict the structure of molecules / ions.
2. To learn the periodic properties of the different groups of compounds focusing on production methods and application of selected elements and compounds.
3. To know the different definitions of acids / bases and predict the reactions between acids and bases.
4. To learn the selected crystal structures and to explain what kind of parameters that affects the crystal structure of a compound.
5. To be able to use Crystal Field Theory to understand the magnetic properties (and in simple terms the colour) of coordination compounds.
6. To be able to describe the stability of metal complexes by the use of formation constants and to calculate thermodynamic parameters from them.

Student Learning Outcomes (SLO):

Students will:

1. Students should be able to explain atomic structure based on quantum mechanics and explain periodic properties of the atoms.
2. Students should be able to explain selected crystal structures explain what kind of parameters that affect the crystal structure of a compound and perform calculations of the lattice enthalpy of ionic compounds.
3. Students should be able to explain the periodic properties of the different groups of compounds focusing on production methods and application of selected elements and compounds.
4. Students should be able to explain the band structure of solids and determine the electrical properties.
5. Students should be able to explaining the theory of the determination of the electron structure of d-metal complexes and explain the properties of these complexes.
6. Students should be able to explain the structure and bonding in molecules and predict the structure of molecules.

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Unit	Syllabus	Periods
UNIT - I	<p>Stereochemistry and Bonding in Main Group Compounds VSEPR, Walsh diagram (tri-and penta-atomic molecules), $d\pi-p\pi$ bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.</p> <p>Metal-Ligand Equilibrium Solution Step wise and over all formation constants and their interaction, trends in step wise 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 pH-metry and spectrophotometry.</p>	12
UNIT - II	<p>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, anation reactions, reactions without metal ligand bond cleavage. Substitution reaction 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.</p>	12
UNIT - III	<p>Metal-Ligand bonding Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory.</p>	12
UNIT - IV	<p>Electronic Spectra and Magnetic Properties of Transition Metal Complexes Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes ($d1-d9$ states), calculations of D, α, β and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical in formation, anomalous magnetic moments, magnetic exchange coupling and spin cross over.</p>	12
UNIT - V	<p>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 ligand.</p> <p>Metal Clusters Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal multiple bonds.</p>	12

REFERENCE BOOKS -

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

Class		M.Sc. Chemistry (Previous)	
Semester/Year		I Year	
Subject & Subject Code		Chemistry - MCHEM20Y102	
Paper		ORGANIC CHEMISTRY Paper- II	
Max. Marks		60	
Credit		Total Credits	
L	T	P	4
3	1	0	
<p>Course Objectives: On completion of the course, students are able to: To learn about optical activity of asymmetric and dissymmetric molecules. Basic idea about aliphatic nucleophilic substitution reactions, aromaticity, aromatic nucleophilic and electrophilic substitution reactions</p>			
<p>Course Outcome: At the end of the course, learners will be able to:</p> <ol style="list-style-type: none"> 1. To learn the concept stereochemistry and its importance. 2. To know what is aliphatic nucleophilic substitution. 3. To understand the various types of aliphatic nucleophilic substitution. 4. To learn what is aromatic substitution reaction. 5. To familiarize the various types of aromatic substitution reaction and their Mechanism. 6. To learn the concept aromaticity. 7. To understand the various types of aromaticity. 8. To learn the stereochemistry substitution and aromaticity. 9. To learn familiar name reactions. 10. To identify the stereochemical notation. 			
<p>Student Learning Outcomes (SLO): Students will:</p> <ol style="list-style-type: none"> 1. Able to recognize either molecule is aromatic, non-aromatic or antiaromatic. 2. Able to describe mechanism of different aliphatic nucleophilic substitution reactions. 3. Able to draw potential energy diagrams. 4. Able to assign R and S to given molecules. 5. Able to do interconversion of Fischer to Newmann, Newmann to Sawhorse and vice versa. 			

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Unit	Syllabus	Periods
UNIT - I	<p>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, ψ aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compounds, catenanes and rotaxanes.</p> <p>Stereo chemistry Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, strain due to unavoidable crowding Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythroisomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereo selective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spirane chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.</p>	12
UNIT - II	<p>Reaction Mechanism: Structure and Reactivity Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotopes effects Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. Effect of structure on reactivity, resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, subsistent and reaction constants, Taft equation.</p> <p>Aliphatic Nucleophilic Substitution The S_N^2, S_N^1 mixed S_N^1 and S_N^2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Classical and non classical carbocations, phenonium ions, norbornyl systems, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations. The S_N^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.</p>	12
UNIT - III	<p>Aromatic Electrophilic Substitution The areniumion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeier reaction, Gatterman-Koch reaction.</p> <p>Aromatic Nucleophilic Substitution The $S_N Ar$ S_N^1, benzyne and S_{RN} mechanism, Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet Hauser, and Smiles rearrangements.</p> <p>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.</p>	12

UNIT - IV	<p>Addition to Carbon-Carbon Multiple Bonds 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.</p> <p>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.</p>	12
UNIT - V	<p>Elimination Reactions The E2, E1 and E1cB 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.</p> <p>Pericyclic Reactions Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n and 4n+2 and allyl systems. Cycloadditions and torafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions. Sigmatropic rearrangements-suprafacial and antarafacial shifts of H, sigmatropic involving carbon moieties, 3,3- and 5,5 sigmatropic rearrangements. Claisen, Cope and azaope rearrangements. Fluxional tautomerism. Ene reaction.</p>	12

REFERENCE BOOKS –

- 1 Advanced Organic Chemistry: Reactions, Mechanism & Structure, Jerry March, J. 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
- 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 &
- 8 Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Mc Millan.
- 9 Pericyclic Reactions, S. M. Mukherji, Mc Millan, India
- 10 Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
- 11 Stereochemistry of Organic Compounds, P. S. Kalsi, New Age International.
- 12 Pericyclic Reactions: Ameta, Sharma, Vardia, Vyas, Sadguru Publications.

Class		M.Sc. Chemistry (Previous)
Semester/Year		I Year
Subject & Subject Code		Chemistry - MCHEM20Y103
Paper		PHYSICAL CHEMISTRY Paper- III
Max. Marks		60
Credit		4
Total Credits		
L	T	
3	1	0

Course Objectives:

On completion of the course, students are able to:

1. To learn about the concept of phase and derivation of phase rule.
2. To understand the Phase diagram for one component system and for two completely miscible component systems.
3. To study eutectic systems and calculation of eutectic point.
4. To understand ClausiusClapeyron equation and its applications.
5. To study kinetics of reaction in solution and influence of pressure, ionic strength, solvent on reaction rates.

Course Outcome:

At the end of the course, learners will be able to:

1. Students will acquire a good knowledge on the chemical kinetics, unimolecular and bimolecular reactions, fast reactions, Catalysis, Surface chemical reactions and Photochemistry of atoms and molecules.
2. An introduction to the chemistry, preparation, structure and physical properties of inorganic nanoparticles. Students will learn about methods to synthesize inorganic nanoparticles, and learn to evaluate particle size and shape distributions.
3. At the end of the class, they will be able to predict the stability of nanoparticles in solution, and to understand the nucleation and growth of nanoparticles.
4. They will know how to analyze the size-dependent physical properties of nanoparticles, and they will know about the different techniques (electron microscopy, X-ray diffraction) to study nanoparticles. Students will also be aware of applications of nanoparticles in science and technology.
5. It is expected that students enrolled in this class have a basic understanding of physical chemistry.

Student Learning Outcomes (SLO):

Students will:

1. Understand the concept of Phase and Gibb's Phase rule.
2. Study Phase diagram for one component and two component systems and calculate eutectic point, congruent and incongruent melting points.
3. Describe Kinetics of reaction in solution and in catalytic reactions.
4. Calculate Michaelis's constant for enzyme-substrate binding by Lineweaver-Burk plot.
5. Understand the concept of distribution and thermodynamic probability.
6. Evaluate most probable distribution state for all type of statics i.e. for Maxwell Boltzmann, Fermi dirac and Bose -Einstein statistics.
7. Understand the concept of partition function, its physical significance and calculation of molar and atomic partition function.

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Unit	Syllabus	Periods
UNIT - I	<p>Quantum Chemistry</p> <p>Introduction to Exact Quantum Mechanical Results The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz. particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.</p> <p>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.</p> <p>Angular Momentum Ordinary angular momentum, generalized angular momentum, eigenfunctions for angular momentum, eigenvalues of angular momentum, operator using ladder operators addition of angular momentum, spin, antisymmetry and Pauli's exclusion principle.</p> <p>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.</p>	12
UNIT - II	<p>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 constant and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity.</p> <p>Non-ideal systems: Excess functions for non-ideal solutions. Activity and 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.</p> <p>Statistical Thermodynamics Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translation, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition. Application of partition functions.</p> <p>Heat capacity behaviour of solids- Chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac statistics, distribution law and applications to metal. Bose-Einstein statistics, distribution law and application to helium.</p> <p>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, irreversible thermodynamics for biological systems, coupled reactions.</p>	12

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UNIT - III	<p>Chemical Dynamics Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reactions).</p>	12
UNIT - IV	<p>Surface Chemistry</p> <p>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), catalytic activity at surfaces.</p> <p>Micelles Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, micro emulsion, reverse micelles.</p> <p>Macro molecules 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 macro molecules, calculation of average dimension of various chain structures.</p>	12
UNIT - V	<p>Electro chemistry of solutions: Debye-Huckel-Onsager treatment and its extension, ion-solvent interactions. Debye-Hückel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Guoy-Chapman, Stern, Grahm Devanathan-Mottwatts, Tobin, Bockris, Devanathan models, Over potentials, exchange current density, derivation of Butler Volmer equation, Tafel plot.</p> <p>Quantum aspects of charge transfer at electrodes- Solution interfaces, quantization of charge transfer, tunneling. Semi conductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface.</p> <p>Electrocatalysis: Influence of various parameters. Hydrogen electrode. Bioelectro chemistry, threshold membrane phenomena, Nernst-Planck equation, hodge-Huxley equation; core conductor models, electro cardiography. Polarography theory, Ilkone equation; half wave potential and its significance. Introduction to corrosion, homogeneous theory, forms of corrosion monitoring and prevention methods.</p>	12

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REFERENCE BOOKS –

- 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 Weeny, ELBS.
- 5 Chemical Kinetics. K.J. Laidler, Mc Graw- Hill.
- 6 Kinetics and Mechanism of Chemical Transformation J. Rajaraman and J. Kuriacose, Mc Millan.

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Class			M.Sc. Chemistry (Previous)		
Semester/Year			I Year		
Subject & Subject Code			Chemistry - MCHEM20Y104		
Paper			Group Theory, Spectroscopy and Diffraction Methods Paper- IV		
Max. Marks			45		
Credit		Total Credits			
L	T	P	3		
3	0	0			
Course Objectives:					
On completion of the course, students are able to:					
1. To introduce the concepts and importance of symmetry and group theory in solving chemical problems.					
2. To impart knowledge of spectroscopic techniques for structural analysis of organic compounds.					
3. To impart the knowledge of electronic, rotation, vibration. NMR, FTIR, ESR, spectroscopy and their applications.					
Course Outcome:					
At the end of the course, learners will be able to:					
1. Concepts of symmetry and group theory in solving chemical structural problems.					
2. Use of character tables and projection operator techniques.					
3. Application of symmetry and group theory in spectroscopy.					
4. Microwave, Infrared-Vibration-rotation Raman and infra-red Spectroscopy and their applications for chemical analysis					
5. Electronic spectroscopy of different elements and simple molecules.					
6. Nuclear Magnetic and Electron Spin Resonance Spectroscopy for organic compounds analysis, medical diagnostics.					
Student Learning Outcomes (SLO):					
Students will:					
1. Describe the selection rule for infrared-active transitions.					
2. Determine the vibrations for a triatomic molecule and identify whether they are infrared-active.					
3. Determine whether the molecular vibrations of a triatomic molecule are Raman active.					
4. Explain the difference between Stokes and anti-Stokes lines in a Raman spectrum.					
3. Justify the difference in intensity between Stokes and anti-Stokes lines.					
5. Draw the Stokes and anti-Stokes lines in a Raman spectrum of a compound when given the energies of the different transitions.					
6. Students will be able to Draw character table and point groups.					

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Unit	Syllabus	Periods
UNIT - I	<p>Symmetry and Group Theory in Chemistry Symmetry elements and symmetry operation, definition of group, sub group, relation between or dersofafinite group all its sub group. Conjugacy relation and classes. Point symmetry group. Sch Ön flies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh}, etc. group to be worked out explicitly). Character of representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy.</p> <p>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 per turbation theory, transition moment, selection rules, intensity of spectral lines, Born-Oppen heimer approximation, rotational, vibrational and electronic energy levels.</p>	9
UNIT - II	<p>Microwave Spectroscopy Classification of molecules, rigid rotator model, effect of isotopic sub stitution on the transition frequencies, intensities, non-rigid rotor. Starkeffect, nuclear and electron spin interaction and effect of external field applications.</p> <p>Vibrational Spectroscopy 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, metallig and vibrations, normal co-ordinate analysis.</p> <p>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).</p>	9
UNIT - III	<p>Electronic Spectroscopy Atomic Spectroscopy Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms.</p> <p>Molecular Spectroscopy Energy levels, molecular orbitals, vibronic tran sitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non- radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.</p> <p>Photoelectron Spectroscopy Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical in formation from ESCA. Auger electron spectroscopy-basic idea.</p>	9

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UNIT - IV	<p>Magnetic Resonance Spectroscopy Nuclear Magnetic Resonance Spectroscopy Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors, in fluencing chemical shift, deshielding, spin-spin interactions, factors in fluencing coupling constant "j" Classification (AVB, AMX, ABC, A2B2 etc.) spindecoupling; basic idea sab out in strument, NMR studies of nuclei other than proton-¹³C, ¹⁹F and ³¹P. FT NMR, advantages of FTNMR, use of NMR in medical diagnostics.</p> <p>Electron Spin Resonance Spectroscopy Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyper fine coupling constants, spin hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications.</p> <p>Nuclear Quadrupole Resonance spectroscopy Quadrupole nuclei, quadrupole moments, electric field gradients, couplingconstant, splitting, applications.</p>	9
UNIT - V	<p>Diffraction Methods X-ray Diffraction Bragg condition, Miller indices, Laue Method, Bragg method, Debye Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cell from systematic absences in diffraction pattern, Structure of simple lattices and X-ray in tensities, structure factor and its relation to intensity and electron density, phase problem. Description of the proced ureforan X-ray structure analysis, absolute configuration of molecules.</p> <p>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.</p> <p>Neutron Diffraction Scattering of neutrons by solids and liquids, magnetic scattering measurement techniques. Elucidation of structure of magnetically ordered unit cell.</p>	9

REFERENCE BOOKS -

- 1 Modern Spectroscopy, J. M. Hollas, John Wiley.
- 2 Applied Electron Spectroscopy for chemical analysised. H. Windawi and F. L. Ho, Wiley Inter science.
- 3 NMR, NQR, EPR and Mössbauer Spectroscopy in Inorganic Chemistry, R. V. Parish, Ellis Harwood.
- 4 Physical Methodsin 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 U V Spectroscopy, H. H. Jaffe and M. Orchin, IBH-Oxford.
- 9 Introduction to Photoelectron Spectroscopy, P. K. Ghosh, John Wiley.
- 10 IntroductiontoMagneticResonance. Acarringtonand A.D. McLachalan, Harper&Row.

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UNIT - II	Carbohydrats On formation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetyl muramicid, sialic acid. Disaccharides and polysaccharides: Structural polysaccharides-cellulose and chitin. Storage polysaccharides - starch and glycogen. Structure and biological functions of glucosE amino glycans or mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism - Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway.	3
UNIT - III	Lipids Fatty acids, essential fatty acids, structure and function of triacyl glycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins- composition and function, role in atherosclerosis. Properties of lipidaggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaicismodel of membrane structure. Lipid metabolism - β -oxidation of fatty acids.	3
UNIT - IV	Amino-acids, Peptides and Proteins Emical and enzymatic hydrolysis of proteins to peptidies, amino acid sequencing. Secondary structure of proteins, for ceresponsible for holding of secondary structures. α - helix, $+\beta$ -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).	3
UNIT - V	NucleicAcids 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 nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.	3

REFERENCE BOOKS -

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

The block contains several handwritten signatures and initials in blue ink. One signature is clearly legible as 'Nidhi'. There are also several other initials and scribbles, including what appears to be 'Jal', 'I', and 'Su'.

Class		M.Sc. Chemistry (Previous)
Semester / Year		I Year
Subject & Subject Code		Practical Chemistry - MCHM20Y108
Paper		Paper- I and Paper- II, Practical
Max. Marks		50= (30+20)
Credit		4
Total Credits		
L	T	
0	0	4

PRACTICALS
Inorganic Chemistry
Qualitative and Quantitative Analysis

- 1 Less common metal ions : Ti, Mo, W, Ta, Zr, Th, V, U (two metal ions in cationic / anionic forms).
- 2 Insolubles: Oxides, sulphates and halides.
- 3 Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.

Chromatography





Separation of cations and anions by

- a. Paper Chromatography
- b. Column Chromatography: Ion exchange

Preparations

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

- 1 $\text{VO}(\text{acac})_2$
- 2 $\text{TiO}(\text{C}_9\text{H}_6\text{NO})_2 \cdot 2\text{H}_2\text{O}$
- 3 $\text{cis-K}[\text{Cr}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O})_2]$
- 4 $\text{Na}[\text{Cr}(\text{NH}_3)_2(\text{SCN})_4]$
- 5 $\text{Mn}(\text{acac})_3$
- 6 $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
- 7 Prussian Blue, Turnbull's Blue.
- 8 $[\text{Co}(\text{NH}_3)_6][\text{Co}(\text{NO}_2)_6]$
- 9 $\text{cis-}[\text{Co}(\text{trien})(\text{NO}_2)_2]\text{Cl} \cdot \text{H}_2\text{O}$
- 10 $\text{Hg}[\text{Co}(\text{SCN})_4]$
- 11 $[\text{Co}(\text{Py})_2\text{Cl}_2]$
- 12 $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$
- 13 $\text{Ni}(\text{dmg})_2$
- 14 $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$

PRACTICAL

Organic Chemistry

Separation, purification and identification of compounds of binary mixture (one liquid and one solid) using T and columns chromatography, chemical tests. IR spectra to be used for functional group identification.

Organic Synthesis

Acetylation : Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.

Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.

Grignard reaction: Synthesis of triphenyl methanol from benzoic acid.

Aldol condensation: Dibenzal acetone from benzaldehyde.

Sandmeyer reaction: p-Chlorotoluene from p-toluidine.

Acetoacetic ester Condensation : Synthesis of ethyl-n-butylacetoacetate by A. E. E. condensation.

Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.

Friedel Crafts reaction : β -Benzoyl propionic acid from succinic anhydride and benzene.

Aromatic electrophilic substitutions: Synthesis of p-nitro aniline and p-bromoaniline. The Products may be Characterized by Spectral Techniques.

Quantitative Analysis

Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.

Estimation of amines/ phenols using bromate bromide solution/ or acetylation method. Determination of Iodine and Saponification values of an oil sample.

Determination of DO, COD and BOD of water sample.

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