

**GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE,
RAJNANDGAON**



TEACHING PLAN

2022-2023

DEPARTMENT OF CHEMISTRY

DEPARTMENT OF CHEMISTRY

SESSION 2022-2023

LESSON PLAN

CLASS-B.Sc. 2nd year

SUBJECT-INORGANIC CHEMISTRY

MONTH	UNIT	TOPICS
July	UNIT-1	CHEMISTRY OF ELEMENTS OF FIRST TRANSITION SERIES Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry
August	UNIT-2	CHEMISTRY OF ELEMENTS OF SECOND & THIRD TRANSITION SERIES General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry
September	UNIT-3	A. OXIDATION AND REDUCTION Use of redox potential data analysis of redox cycle, redox stability in water-Frost, Latimer & Pourbaix diagrams. Principles involved in the extraction of the elements. B. COORDINATION COMPOUNDS Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes
October	UNIT-4	A. CHEMISTRY OF LANTHANIDE ELEMENTS Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.
November	UNIT-4	B. CHEMISTRY OF ACTINIDES General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from uranium, similarities between the later actinides and the later lanthanides
December	UNIT-5	A. ACID AND BASES Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases
January	UNIT-5	N. NON-AQUEOUS SOLVENTS 06 HRS Physical properties of a solvent, types of solvents and their general characteristics, reaction in non-aqueous solvents with reference to liquid ammonia and liquid sulphur dioxide.

DEPARTMENT OF CHEMISTRY

SESSION 2022-2023

LESSON PLAN

CLASS M.Sc Ist SEM

Paper-1(CO-ORDINATION CHEMISTRY)

Paper-3(MATHEMATICS FOR CHEMISTS, QUANTUM CHEMISTRY AND CHEMICAL DYNAMICS)

Month	Unit	Topics
September	Unit -II	Metal π-Complexes π -acceptor ligands, 18 e rule, Hapticity, preparation and chemical properties of sandwich compounds, preparation and chemical properties of metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation.
October	Unit -II	Important reactions of metal carbonyls: preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.
November	Unit -IV	Chemical Dynamics Method of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reaction, kinetic salt effects, steady state kinetics. Photochemical reaction (hydrogen-bromine and hydrogen-chlorine reactions).
December	Unit -IV	Homogeneous catalysis, kinetics of enzyme reaction, general features of fast reaction, study of fast reaction by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method. Dynamics of unimolecular reaction, Lindmann-Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reaction.

DEPARTMENT OF CHEMISTRY

SESSION 2022-2023

LESSON PLAN

CLASS M.Sc IInd SEM

Paper 1 (TRANSITION METAL COMPLEXES AND DIFFRACTION METHODS)

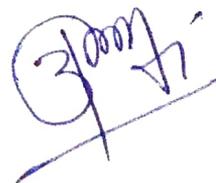
Month	Unit	Topics
January	Unit-IV	X-Ray Diffraction Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-Ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern.
February	Unit-IV	Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem, Ramchandran Diagram.
March	Unit-IV	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 solid and liquids, magnetic scattering, measurement techniques, Elucidation of structure of magnetically ordered unit cell.

CLASS-M Sc.IIIrdSEM

Paper -3(ORGANOTRANSITION METAL COMPLEXES)

Paper-4(PHOTOINORGANIC AND ANALYTICAL CHEMISTRY)

Month	Unit	Topics
September	Unit-III	Transition Metal Compounds with Bonds to Hydrogen - Preparation and characterization of Transition metal compounds with Bonds to hydrogen.
October	Unit-III	Fluxional organometallic Compounds- Fluxional and dynamic equilibria in compounds such as η^2 olefin, η^3 allyl and diene complexes. Sandwich Compounds:- Ferrocene and other Metallocene, preparation, reaction and their spectral
November	Unit-II	Fuel analysis Liquid and gas, liquid fuels, flash point, aniline points octane number, gaseous fuels, producer gas and water gas –calorific value.
December	Unit II	Clinical chemistry Composition of blood collection and preservation sample, clinical analysis, serum electrolytes, blood glucose, blood urea, uric acid, albumin barbiturary, immunoassay principle radioimmunoassay (RIA) and application. The blood group analysis, trace elements in the body.



CLASS M.Sc.IVthSEM

Paper -2(ENVIRONMENTAL CHEMISTRY)

Paper-4(CHEMISTRY OF MATERIALS & RADIOCHEMISTRY)

Month	Unit	Topics
January	Unit-I	<p>Environment</p> <p>Introduction, composition of atmosphere, vertical temperature budget of the earth atmosphere system, vertical stability atmosphere. Biogeochemical cycles of C.N.P.S. and biodistribution of elements</p>
February	Unit-I	<p>Chemistry of materials Multiphase Materials</p> <p>Ferrous alloys, stainless steels, and nonferrous alloys, properties of ferrous and non-ferrous alloys and their application</p>
March	Unit-I	<p>Glasses, ceramics and refractories</p> <p>Glassy state, glass formers and glass modifiers, application. Ceramic structures, Mechanical properties clay products. Refractories, characterizations, properties & application</p>



DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

FACULTY NAME :- LIKESHWAR SINHA

Class: - B.SC. II

Subject: -Organic Chemistry

MONTH	UNIT	TOPICS
July	UNIT-1	<p>ALCOHOLS</p> <p>A. Dihydric alcohols - nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc)₄ and HIO₄] and pinacol - pinacolone rearrangement.</p> <p>B. Trihydric alcohols - nomenclature and methods of formation, chemical reactions of glycerol.</p> <p>PHENOLS</p> <p>A. Structure and bonding, in phenols, physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, acylation and carboxylation.</p> <p>B. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben - Hoesch reaction, Lederer - Manasse reaction and Reimer-Tiemann reaction.</p> <p>EPOXIDES</p> <p>Synthesis of epoxides. Catalysed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.</p> <p>Anti</p> <p>1,2 dihydroxylation of alkenes via epoxides. Crown ethers.</p>
August	UNIT-2	<p>ALDEHYDES AND KETONES</p> <p>A. Nomenclature and Structure of the carbonyl group. Synthesis of aldehydes and ketones using 1,3 - dithianes, synthesis of ketones from nitriles. Mechanism of nucleophilic additions to carbonyl group Benzoin, Aldol, Perkin and Knoevenagel condensations. Condensations with ammonia and its derivatives, Wittig reaction, Mannich reaction.</p> <p>B. Use of acetate as protecting group, Oxidation of aldehydes, Baeyer - Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen Condensation, Wolff-Kishner reaction, LiAlH₄ and NaBH₄ reduction. Halogenation of enolizable ketones.</p> <p>An introduction to α,β unsaturated aldehydes and ketones.</p>
September	UNIT-3	<p>A. CARBOXYLIC ACIDS 05 HRS.</p> <p>Structure and bonding, Physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Hell-Volhard Zeilinsky reaction. Reduction of carboxylic acids. Mechanism of Decarboxylation.</p> <p>Methods of formation and chemical reactions of unsaturated mono carboxylic acids. Di carboxylic acids : methods of formation and effect of heat and dehydrating agents.</p> <p>B. SUBSTITUTED CARBOXYLIC ACIDS</p> <p>Hydroxy and Halo-substituted Acids.</p> <p>C. CARBOXYLIC ACID DERIVATIVES</p>

		Structure of acid chlorides, esters, amides and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of acid and base catalyzed esterification and hydrolysis.
October	UNIT-4	ORGANIC COMPOUNDS OF NITROGEN A. Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline medium.
November	UNIT-4	B. Reactivity, Structure and nomenclature of amines, physical properties. Stereochemistry of amines. Separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel - phthalimide reaction, Hofmann bromamide reaction, Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.
December	UNIT-5	HETEROCYCLIC COMPOUNDS A. Introduction Molecular orbital picture and aromatic character of pyrrole, furan, thiophene and pyridine, methods of synthesis and chemical reactions with emphasis on the mechanism of electrophilic substitution. Mechanism and nucleophilic substitution reaction in pyridine derivatives. Comparison of basicity of pyridine. Piperidine and pyrrole.
January	UNIT-5	B. Preparation and reaction of Indole, quinoline and isoquinoline and with special reference to Fisher Indole synthesis and Skraup synthesis and Bisher-Napieralski synthesis, Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Previous (I Semester)

Subject: Coordination Chemistry and Physical Chemistry (Paper I)

Month	Unit	Topics covered
July	Unit III	<u>Reaction Mechanism of Transition Metal Complexes</u> 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.
August	Unit III	<u>Reaction Mechanism of Transition Metal Complexes</u> Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reaction, cross reactions and Marcus-Hush theory, inner sphere type reactions.
September	Unit III	<u>Chemical Dynamics</u> Method of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reaction.
November	Unit IV	<u>Chemical Dynamics</u> Kinetic salt effects, steady state kinetics. Photochemical reaction (hydrogen-bromine and hydrogen-chlorine reactions).

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Previous (II Semester)

Subject: - Coordination Chemistry (Paper IV)

Month	Unit	Topics covered
July	Unit II	Electromagnetic radiation, interaction of electromagnetic radiation with matter absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering.
August	Unit II	Uncertainty relation and natural line width and natural line broadening, transition probability, results of the time dependent perturbation theory, transmission moment, selection rules, intensity of spectral lines. Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels.
September	Unit III	<u>Micelles</u> Surface active agents, classification of surface active agents, micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, reverse micelles.
October	Unit IV	<u>Macromolecules</u> Polymer: Definition, types of polymers, electrically conducting polymers, 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 dimensions of various chain structures.

November	Unit IV	<u>Classical Thermodynamics</u> Brief resume of concept of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity. Non-Ideal system. Excess function for non-ideal solutions, activity, activity coefficient. Debye-Huckel theory for activity coefficient of electrolyte solution, determination of activity and activity coefficients, ionic strength. Application of phase rule to three component systems.
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DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Final (III Semester)

Subject: - Organometallic Chemistry (Paper III)

Month	Unit	Topics covered
July	Unit III	<u>Alkyls and Aryl of Transition Metals</u> Type, routes of synthesis, stability & decomposition pathways.
August	Unit III	<u>Compound of Transition Metals- Carbon Multiple Bonds</u> Alkylidenes, alkylidynes, low valent carbene & carbene synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reaction on the ligands.
September	Unit III	<u>Transition Metal π-Complexes</u> Transition Metal- π complexes with unsaturated organ molecules.
October	Unit IV	<u>Transition Metal π-Complexes</u> Alkenes, alkynes, diene dienyl, arene and complexes, preparation, properties, nature of bonding and structural features and their characterization.
November	Unit IV	<u>Transition Metal π-Complexes</u> Important reactions relating to nucleophilic and electrophilic attack on ligands.

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Final (IV Semester)

Subject: - Physical Chemistry

Month	Unit	Topics covered
July	Unit III	<u>Metalloenzymes</u> Zinc enzymes- Carboxypeptidase, Carbonic anhydrase, Iron enzymes- catalase, peroxidase and cytochrome P-450.
August	Unit III	<u>Metalloenzymes</u> Copper enzyme – superoxide dismutase. Molybdenum Oxatransferase enzyme- Xanthine oxidase. Coenzyme vitamin B
September	Unit III	<u>Mechanism of Polymerization</u> Basic concepts- Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: Mechanism of condensation polymerization, mechanism of addition polymerization – free radical chain, cationic, anionic, coordination and mechanism of copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems
October	Unit IV	<u>Kinetics and Statistics of Polymerization</u> Kinetics and statistics of stepwise polymerization – reactivity and molecular size, kinetics and statistics, molecular weight control. Kinetics of free radical chain polymerization, equation for kinetic chain length, degree of polymerization and chain transfer;

November	Unit IV	<u>Kinetics and Statistics of Polymerization</u> Kinetics of cationic polymerization; kinetics of anionic polymerization. Kinetics of heterogeneous polymerization using Ziegler Natta catalysts
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DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - B.SC. I SEMESTER

Subject: - DSC (Organic Chemistry)

Month	Unit	Topics covered
July	Unit III	<u>Fundamentals of Organic Chemistry</u> Influence of hybridization on bond properties, Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Huckels rule.
August	Unit III	<u>Stereochemistry :</u> Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; cis-trans nomenclature; CIP Rules: R/S (for one chiral carbon atoms) and E/Z Nomenclature (for up to two C=C systems).
September	Unit III	<u>Aliphatic Hydrocarbons</u> Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbes synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.
October	Unit IV	<u>Alkenes: (Upto 5 Carbons)</u> Preparation: Elimination reactions: Dehydration of alkenes and dehydro-halogenation of alkyl halides (Saytzes rule);

		cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO_4) and trans-addition (bromine), Addition of HX (Markownikoffs and anti-Markownikoffs addition), Hydration, Ozonolysis
November	Unit IV	<u>Alkynes: (Upto 5 Carbons)</u> Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by de-halogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis.

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - B.SC. II SEMESTER

Subject: - (Inorganic Chemistry)

Month	Unit	Topics covered
July	Unit III	<u>s- and p-Block Elements</u> Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling & Mulliken scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.
August	Unit III	<u>Compounds of s- and p-Block Elements</u> Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.
September	Unit III	<u>Compounds of representative elements</u> Hydrides of nitrogen (NH ₃ ; N ₂ H ₄ ; N ₃ H; NH ₂ OH) Oxoacids of P, S and Cl. Halides and oxohalides: PCl ₃ ; PCl ₅ ; SOCl ₂
October	Unit IV	<u>Chemistry of elements of transition series</u> Characteristic properties of d-block elements. Properties of elements of first, second & third transition series, their binary compounds and complexes illustrating relative stability of their oxidation states.
November		<u>Chemistry of elements of transition series</u> Coordination number and geometry, magnetic behaviour, spectral properties and stereochemistry

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - B.SC. II year

Subject: -Physical Chemistry

Month	Unit	Topics covered
July	Unit I	<u>Thermodynamics-I</u> Intensive and extensive variables; state and path functions; isolated, closed and open systems; Zeroth law of thermodynamics. First law: Concept of heat, work, internal energy and statement of first law; enthalpy, Relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases under isothermal and adiabatic conditions. Joule-Thompson expansion, inversion temperature of gases, expansion of ideal gases under isothermal and adiabatic condition
August	Unit I	<u>Thermo chemistry</u> Laws of Thermochemistry, Heats of reactions, standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature
September	Unit II	<u>Thermodynamics II</u> Second Law of Thermodynamics: Spontaneous process, need of second law, Statement of Carnot cycle and efficiency of heat engine, Carnot's theorem, thermodynamic state of temperature. Concept of entropy: Entropy change in a reversible and irreversible process, entropy change in isothermal reversible expansion of an ideal gas, entropy change in isothermal mixing of ideal gases, physical signification of entropy,

		<p>Molecular and statistical interpretation of entropy. Gibbs and Helmholtz free energy, variation of G and A with pressure, volume, temperature, Gibbs-Helmholtz equation. Maxwell relation, Elementary idea of Third law of Thermodynamics, concepts of residual entropy, calculation of absolute entropy of molecule.</p>
October	Unit IV	<p><u>Chemical Equilibrium</u></p> <p>Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Concept of Fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exergonic and endergonic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x. Le Chatelier principle (quantitative treatment). Equilibrium between ideal gas and a pure condensed phase</p>
November	Unit V	<p><u>Ionic Equilibrium</u></p> <p>Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono protic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.</p>
December		<p><u>Phase Equilibrium</u></p> <p>Phase rule, Phase, component and degree of freedom, derivation of Gibbs phase rule, Clausius-claperon equation and its application to solid -Liquid, Liquid -Vapor and solid Vapor, limitation of phase rule, applications of phase rule to one component system: Water system and sulphur system, Application of phase rule to two component system: Pb-Ag system, Zn-Mg system, Ferric chloride-water system, desilveriaztion of lead, congruent and incongruent, melting point and eutectic point, Three component system: Solid solution liquid pairs. Nerst distribution law, Henry's law, application, solvent extraction</p>
January		<p><u>Photochemistry</u></p> <p>Characteristics of electromagnetic radiation, Interaction of</p>

		<p>radiation with matter, difference between thermal and photochemical processes, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry: Grothus-Draper law, Stark-Einstein law, quantum yield, actinometry, examples of low and high quantum yields. Photochemical equilibrium and the differential rate of photochemical reactions, Quenching Role of photochemical reaction in biochemical process. Jablonski diagram depicting various process occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), photosensitized reactions, energy transfer processes {simple examples}, photostationary states chemiluminescence,</p>
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DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Previous (I Semester)

Subject: Coordination Chemistry and Physical Chemistry (Paper I)

Month	Unit	Topics covered
July	Unit III	<u>Reaction Mechanism of Transition Metal Complexes</u> 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.
August	Unit III	<u>Reaction Mechanism of Transition Metal Complexes</u> Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reaction, cross reactions and Marcus-Hush theory, inner sphere type reactions.
September	Unit III	<u>Chemical Dynamics</u> Method of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reaction.
November	Unit IV	<u>Chemical Dynamics</u> Kinetic salt effects, steady state kinetics. Photochemical reaction (hydrogen-bromine and hydrogen-chlorine reactions).

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Previous (II Semester)

Subject: - Coordination Chemistry (Paper II)

Month	Unit	Topics covered
July	Unit III	<u>Lanthanoids and actinoids</u> Introduction, occurrence, physical and chemical properties, electronic spectra and magnetic properties-oxidation states, term symbols, color transition, organometallic compounds and recent applications
August	Unit III	<u>Surface Chemistry</u> Adsorption Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Gibbs adsorption isotherm, BET equation and estimation of surface area using BET equation.
September	Unit III	<u>Micelles</u> Surface active agents, classification of surface active agents, micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, reverse micelles.
October	Unit IV	<u>Macromolecules</u> Polymer: Definition, types of polymers, electrically conducting polymers, 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 dimensions of various chain structures.

November	Unit IV	<u>Classical Thermodynamics</u> Brief resume of concept of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity. Non-Ideal system. Excess function for non-ideal solutions, activity, activity coefficient. Debye-Huckel theory for activity coefficient of electrolyte solution, determination of activity and activity coefficients, ionic strength. Application of phase rule to three component systems.
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DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Final (III Semester)

Subject: - Organometallic Chemistry (Paper III)

Month	Unit	Topics covered
July	Unit III	<u>Alkyls and Aryl of Transition Metals</u> Type, routes of synthesis, stability & decomposition pathways.
August	Unit III	<u>Compound of Transition Metals- Carbon Multiple Bonds</u> Alkylidenes, alkylidynes, low valent carbene & carbene synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reaction on the ligands.
September	Unit III	<u>Transition Metal π-Complexes</u> Transition Metal- π complexes with unsaturated organ molecules.
October	Unit IV	<u>Transition Metal π-Complexes</u> Alkenes, alkynes, diene dienyl, arene and complexes, preparation, properties, nature of bonding and structural features and their characterization.
November	Unit IV	<u>Transition Metal π-Complexes</u> Important reactions relating to nucleophilic and electrophilic attack on ligands.

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Final (IV Semester)

Subject: - Physical Chemistry

Month	Unit	Topics covered
July	Unit III	<u>Metalloenzymes</u> Zinc enzymes- Carboxypeptidase, Carbonic anhydrase, Iron enzymes- catalase, peroxidase and cytochrome P-450.
August	Unit III	<u>Metalloenzymes</u> Copper enzyme – superoxide dismutase. Molybdenum Oxatransferase enzyme- Xanthine oxidase. Coenzyme vitamin B
September	Unit III	<u>Mechanism of Polymerization</u> Basic concepts- Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: Mechanism of condensation polymerization, mechanism of addition polymerization – free radical chain, cationic, anionic, coordination and mechanism of copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems
October	Unit IV	<u>Kinetics and Statistics of Polymerization</u> Kinetics and statistics of stepwise polymerization – reactivity and molecular size, kinetics and statistics, molecular weight control. Kinetics of free radical chain polymerization, equation for kinetic chain length, degree of polymerization and chain transfer;

November	Unit IV	<u>Kinetics and Statistics of Polymerization</u> Kinetics of cationic polymerization; kinetics of anionic polymerization. Kinetics of heterogeneous polymerization using Ziegler Natta catalysts
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DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

FACULTY NAME :- VIKAS KANDE

Class: - B.SC. I SEMESTER

Subject: - DSC (Organic Chemistry)

Month	Unit	Topics covered
July	Unit III	<u>Stereochemistry :</u> Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; cis-trans nomenclature; CIP Rules: R/S (for one chiral carbon atoms) and E/Z Nomenclature (for up to two C=C systems).
August	Unit III	<u>Fundamentals of Organic Chemistry</u> Influence of hybridization on bond properties, Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Huckels rule.
September	Unit III	<u>Aliphatic Hydrocarbons</u> Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbes synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.
October	Unit IV	<u>Alkenes: (Upto 5 Carbons)</u> Preparation: Elimination reactions: Dehydration of alkenes

		and dehydro-halogenation of alkyl halides (Saytzes rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO_4) and trans-addition (bromine), Addition of HX (Markownikoffs and anti-Markownikoffs addition), Hydration, Ozonolysis
November	Unit IV	<u>Alkynes: (Upto 5 Carbons)</u> Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by de-halogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis.

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - B.SC. II SEMESTER

Subject: - (Inorganic Chemistry)

Month	Unit	Topics covered
July	Unit III	<u>s- and p-Block Elements</u> Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling & Mulliken scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.
August	Unit III	<u>Compounds of s- and p-Block Elements</u> Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.
September	Unit III	<u>Compounds of representative elements</u> Hydrides of nitrogen (NH ₃ ; N ₂ H ₄ ; N ₃ H; NH ₂ OH) Oxoacids of P, S and Cl. Halides and oxohalides: PCl ₃ ; PCl ₅ ; SOCl ₂
October	Unit IV	<u>Chemistry of elements of transition series</u> Characteristic properties of d-block elements. Properties of elements of first, second & third transition series, their binary compounds and complexes illustrating relative stability of their oxidation states.
November		<u>Chemistry of elements of transition series</u> Coordination number and geometry, magnetic behaviour, spectral properties and stereochemistry

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - B.SC. II year

Subject: -Physical Chemistry

Month	Unit	Topics covered
July	Unit I	<u>Thermodynamics-I</u> Intensive and extensive variables; state and path functions; isolated, closed and open systems; Zeroth law of thermodynamics. First law: Concept of heat, work, internal energy and statement of first law; enthalpy, Relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases under isothermal and adiabatic conditions. Joule-Thompson expansion, inversion temperature of gases, expansion of ideal gases under isothermal and adiabatic condition
August	Unit I	<u>Thermo chemistry</u> Laws of Thermochemistry, Heats of reactions, standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature
September	Unit II	<u>Thermodynamics II</u> Second Law of Thermodynamics: Spontaneous process, need of second law, Statement of Carnot cycle and efficiency of heat engine, Carnot's theorem, thermodynamic state of temperature. Concept of entropy: Entropy change in a reversible and irreversible process, entropy change in isothermal reversible

		expansion of an ideal gas, entropy change in isothermal mixing of ideal gases, physical signification of entropy, Molecular and statistical interpretation of entropy. Gibbs and Helmholtz free energy, variation of G and A with pressure, volume, temperature, Gibbs-Helmholtz equation. Maxwell relation, Elementary idea of Third law of Thermodynamics, concepts of residual entropy, calculation of absolute entropy of molecule.
October	Unit IV	<p><u>Chemical Equilibrium</u></p> <p>Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Concept of Fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exergonic and endergonic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x. Le Chatelier principle (quantitative treatment). Equilibrium between ideal gas and a pure condensed phase</p>
November	Unit V	<p><u>Ionic Equilibrium</u></p> <p>Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono protic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.</p>
December		<p><u>Phase Equilibrium</u></p> <p>Phase rule, Phase, component and degree of freedom, derivation of Gibbs phase rule, Clausius-claperon equation and its application to solid -Liquid, Liquid -Vapor and solid Vapor, limitation of phase rule, applications of phase rule to one component system: Water system and sulphur system, Application of phase rule to two component system: Pb-Ag system, Zn-Mg system, Ferric chloride-water system, desilveriazation of lead, congruent and incongruent, melting point and eutectic point, Three component system: Solid solution liquid pairs. Nerst distribution law, Henry's law, application, solvent extraction</p>
January		<u>Photochemistry</u>

		<p>Characteristics of electromagnetic radiation, Interaction of radiation with matter, difference between thermal and photochemical processes, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry: Grothus-Drapper law, Stark-Einstein law, quantum yield, actinometry, examples of low and high quantum yields. Photochemical equilibrium and the differential rate of photochemical reactions, Quenching Role of photochemical reaction in biochemical process. Jablonski diagram depicting various process occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), photosensitized reactions, energy transfer processes {simple examples}, photostationary states chemiluminescence,</p>
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DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Previous (I Semester)

Subject: Coordination Chemistry and Physical Chemistry (Paper I)

Month	Unit	Topics covered
July	Unit III	<u>Reaction Mechanism of Transition Metal Complexes</u> 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.
August	Unit III	<u>Reaction Mechanism of Transition Metal Complexes</u> Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reaction, cross reactions and Marcus-Hush theory, inner sphere type reactions.
September	Unit III	<u>Chemical Dynamics</u> Method of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reaction.
November	Unit IV	<u>Chemical Dynamics</u> Kinetic salt effects, steady state kinetics. Photochemical reaction (hydrogen-bromine and hydrogen-chlorine reactions).

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Previous (II Semester)

Subject: - Coordination Chemistry (Paper II)

Month	Unit	Topics covered
July	Unit III	<u>Lanthanoids and actinoids</u> Introduction, occurrence, physical and chemical properties, electronic spectra and magnetic properties-oxidation states, term symbols, color transition, organometallic compounds and recent applications
August	Unit III	<u>Surface Chemistry</u> Adsorption Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Gibbs adsorption isotherm, BET equation and estimation of surface area using BET equation.
September	Unit III	<u>Micelles</u> Surface active agents, classification of surface active agents, micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, reverse micelles.
October	Unit IV	<u>Macromolecules</u> Polymer: Definition, types of polymers, electrically conducting polymers, 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 dimensions of various chain structures.
November	Unit IV	<p><u>Classical Thermodynamics</u></p> <p>Brief resume of concept of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity. Non-Ideal system. Excess function for non-ideal solutions, activity, activity coefficient. Debye-Huckel theory for activity coefficient of electrolyte solution, determination of activity and activity coefficients, ionic strength. Application of phase rule to three component systems.</p>

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Final (III Semester)

Subject: - Organometallic Chemistry (Paper III)

Month	Unit	Topics covered
July	Unit III	<u>Alkyls and Aryl of Transition Metals</u> Type, routes of synthesis, stability & decomposition pathways.
August	Unit III	<u>Compound of Transition Metals- Carbon Multiple Bonds</u> Alkylidenes, alkylidynes, low valent carbene & carbene synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reaction on the ligands.
September	Unit III	<u>Transition Metal π-Complexes</u> Transition Metal- π complexes with unsaturated organ molecules.
October	Unit IV	<u>Transition Metal π-Complexes</u> Alkenes, alkynes, diene dienyl, arene and complexes, preparation, properties, nature of bonding and structural features and their characterization.
November	Unit IV	<u>Transition Metal π-Complexes</u>

		Important reactions relating to nucleophilic and electrophilic attack on ligands.
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DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Final (IV Semester)

Subject: - Physical Chemistry

Month	Unit	Topics covered
July	Unit III	<u>Metalloenzymes</u> Zinc enzymes- Carboxypeptidase, Carbonic anhydrase, Iron enzymes- catalase, peroxidase and cytochrome P-450.
August	Unit III	<u>Metalloenzymes</u> Copper enzyme – superoxide dismutase. Molybdenum Oxatransferase enzyme- Xanthine oxidase. Coenzyme vitamin B
September	Unit III	<u>Mechanism of Polymerization</u> Basic concepts- Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: Mechanism of condensation polymerization, mechanism of addition polymerization – free radical chain, cationic, anionic, coordination and mechanism of copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems
October	Unit IV	<u>Kinetics and Statistics of Polymerization</u> Kinetics and statistics of stepwise polymerization – reactivity and molecular size, kinetics and statistics,

		molecular weight control. Kinetics of free radical chain polymerization, equation for kinetic chain length, degree of polymerization and chain transfer;
November	Unit IV	<p><u>Kinetics and Statistics of Polymerization</u></p> <p>Kinetics of cationic polymerization; kinetics of anionic polymerization. Kinetics of heterogeneous polymerization using Ziegler Natta catalysts</p>

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

FACULTY NAME :- YOUNUS RAZA BEG

Class: - B.SC. I SEMESTER

Subject: - DSC (Organic Chemistry)

Month	Unit	Topics covered
July	Unit III	<u>Stereochemistry :</u> Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; cis-trans nomenclature; CIP Rules: R/S (for one chiral carbon atoms) and E/Z Nomenclature (for up to two C=C systems).
August	Unit III	<u>Fundamentals of Organic Chemistry</u> Influence of hybridization on bond properties, Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Huckels rule.
September	Unit III	<u>Aliphatic Hydrocarbons</u> Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbes synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.
October	Unit IV	<u>Alkenes: (Upto 5 Carbons)</u> Preparation: Elimination reactions: Dehydration of alkenes

		and dehydro-halogenation of alkyl halides (Saytzes rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO_4) and trans-addition (bromine), Addition of HX (Markownikoffs and anti-Markownikoffs addition), Hydration, Ozonolysis
November	Unit IV	<u>Alkynes: (Upto 5 Carbons)</u> Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by de-halogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis.

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - B.SC. II SEMESTER

Subject: - (Inorganic Chemistry)

Month	Unit	Topics covered
July	Unit III	<u>s- and p-Block Elements</u> Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling & Mulliken scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.
August	Unit III	<u>Compounds of s- and p-Block Elements</u> Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.
September	Unit III	<u>Compounds of representative elements</u> Hydrides of nitrogen (NH ₃ ; N ₂ H ₄ ; N ₃ H; NH ₂ OH) Oxoacids of P, S and Cl. Halides and oxohalides: PCl ₃ ; PCl ₅ ; SOCl ₂
October	Unit IV	<u>Chemistry of elements of transition series</u> Characteristic properties of d-block elements. Properties of elements of first, second & third transition series, their binary compounds and complexes illustrating relative stability of their oxidation states.
November		<u>Chemistry of elements of transition series</u> Coordination number and geometry, magnetic behaviour, spectral properties and stereochemistry

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - B.SC. II year

Subject: -Physical Chemistry

Month	Unit	Topics covered
July	Unit I	<u>Thermodynamics-I</u> Intensive and extensive variables; state and path functions; isolated, closed and open systems; Zeroth law of thermodynamics. First law: Concept of heat, work, internal energy and statement of first law; enthalpy, Relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases under isothermal and adiabatic conditions. Joule-Thompson expansion, inversion temperature of gases, expansion of ideal gases under isothermal and adiabatic condition
August	Unit I	<u>Thermo chemistry</u> Laws of Thermochemistry, Heats of reactions, standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature
September	Unit II	<u>Thermodynamics II</u> Second Law of Thermodynamics: Spontaneous process, need of second law, Statement of Carnot cycle and efficiency of heat engine, Carnot's theorem, thermodynamic state of temperature. Concept of entropy: Entropy change in a reversible and irreversible process, entropy change in isothermal reversible

		<p>expansion of an ideal gas, entropy change in isothermal mixing of ideal gases, physical signification of entropy, Molecular and statistical interpretation of entropy. Gibbs and Helmholtz free energy, variation of G and A with pressure, volume, temperature, Gibbs-Helmholtz equation. Maxwell relation, Elementary idea of Third law of Thermodynamics, concepts of residual entropy, calculation of absolute entropy of molecule.</p>
October	Unit IV	<p><u>Chemical Equilibrium</u></p> <p>Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Concept of Fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exergonic and endergonic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x. Le Chatelier principle (quantitative treatment). Equilibrium between ideal gas and a pure condensed phase</p>
November	Unit V	<p><u>Ionic Equilibrium</u></p> <p>Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono protic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.</p>
December		<p><u>Phase Equilibrium</u></p> <p>Phase rule, Phase, component and degree of freedom, derivation of Gibbs phase rule, Clausius-claperon equation and its application to solid -Liquid, Liquid -Vapor and solid Vapor, limitation of phase rule, applications of phase rule to one component system: Water system and sulphur system, Application of phase rule to two component system: Pb-Ag system, Zn-Mg system, Ferric chloride-water system, desilveriazation of lead, congruent and incongruent, melting point and eutectic point, Three component system: Solid solution liquid pairs. Nerst distribution law, Henry's law, application, solvent extraction</p>
January		<p><u>Photochemistry</u></p>

		<p>Characteristics of electromagnetic radiation, Interaction of radiation with matter, difference between thermal and photochemical processes, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry: Grothus-Drapper law, Stark-Einstein law, quantum yield, actinometry, examples of low and high quantum yields. Photochemical equilibrium and the differential rate of photochemical reactions, Quenching Role of photochemical reaction in biochemical process. Jablonski diagram depicting various process occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), photosensitized reactions, energy transfer processes {simple examples}, photostationary states chemiluminescence,</p>
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DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Previous (I Semester)

Subject: Coordination Chemistry and Physical Chemistry (Paper I)

Month	Unit	Topics covered
July	Unit III	<u>Reaction Mechanism of Transition Metal Complexes</u> 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.
August	Unit III	<u>Reaction Mechanism of Transition Metal Complexes</u> Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reaction, cross reactions and Marcus-Hush theory, inner sphere type reactions.
September	Unit III	<u>Chemical Dynamics</u> Method of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, ionic reaction.
November	Unit IV	<u>Chemical Dynamics</u> Kinetic salt effects, steady state kinetics. Photochemical reaction (hydrogen-bromine and hydrogen-chlorine reactions).

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Previous (II Semester)

Subject: - Coordination Chemistry (Paper II)

Month	Unit	Topics covered
July	Unit III	<u>Lanthanoids and actinoids</u> Introduction, occurrence, physical and chemical properties, electronic spectra and magnetic properties-oxidation states, term symbols, color transition, organometallic compounds and recent applications
August	Unit III	<u>Surface Chemistry</u> Adsorption Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Gibbs adsorption isotherm, BET equation and estimation of surface area using BET equation.
September	Unit III	<u>Micelles</u> Surface active agents, classification of surface active agents, micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, reverse micelles.
October	Unit IV	<u>Macromolecules</u> Polymer: Definition, types of polymers, electrically conducting polymers, 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 dimensions of various chain structures.
November	Unit IV	<p><u>Classical Thermodynamics</u></p> <p>Brief resume of concept of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity. Non-Ideal system. Excess function for non-ideal solutions, activity, activity coefficient. Debye-Huckel theory for activity coefficient of electrolyte solution, determination of activity and activity coefficients, ionic strength. Application of phase rule to three component systems.</p>

DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Final (III Semester)

Subject: - Organometallic Chemistry (Paper III)

Month	Unit	Topics covered
July	Unit III	<u>Alkyls and Aryl of Transition Metals</u> Type, routes of synthesis, stability & decomposition pathways.
August	Unit III	<u>Compound of Transition Metals- Carbon Multiple Bonds</u> Alkylidenes, alkylidynes, low valent carbene & carbene synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reaction on the ligands.
September	Unit III	<u>Transition Metal π-Complexes</u> Transition Metal- π complexes with unsaturated organ molecules.
October	Unit IV	<u>Transition Metal π-Complexes</u> Alkenes, alkynes, diene dienyl, arene and complexes, preparation, properties, nature of bonding and structural features and their characterization.
November	Unit IV	<u>Transition Metal π-Complexes</u>

		Important reactions relating to nucleophilic and electrophilic attack on ligands.
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DEPARTMENT OF CHEMISTRY

Session 2022-23

Lesson Plan

Class: - M.Sc. Final (IV Semester)

Subject: - Physical Chemistry

Month	Unit	Topics covered
July	Unit III	<u>Metalloenzymes</u> Zinc enzymes- Carboxypeptidase, Carbonic anhydrase, Iron enzymes- catalase, peroxidase and cytochrome P-450.
August	Unit III	<u>Metalloenzymes</u> Copper enzyme – superoxide dismutase. Molybdenum Oxatransferase enzyme- Xanthine oxidase. Coenzyme vitamin B
September	Unit III	<u>Mechanism of Polymerization</u> Basic concepts- Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: Mechanism of condensation polymerization, mechanism of addition polymerization – free radical chain, cationic, anionic, coordination and mechanism of copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems
October	Unit IV	<u>Kinetics and Statistics of Polymerization</u> Kinetics and statistics of stepwise polymerization – reactivity and molecular size, kinetics and statistics,

		molecular weight control. Kinetics of free radical chain polymerization, equation for kinetic chain length, degree of polymerization and chain transfer;
November	Unit IV	<u>Kinetics and Statistics of Polymerization</u> Kinetics of cationic polymerization; kinetics of anionic polymerization. Kinetics of heterogeneous polymerization using Ziegler Natta catalysts

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -BSc I Semester

Subject – Fundamental of inorganic and organic chemistry

Month	Unit	Topic
July	Unit 1	Review of: Bohr's theory and its limitations, dual behavior of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s
August	Unit 1	Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (MS). Rules for filling electrons in various orbitals, electronic configurations of the atoms. Stability of half-filled and filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.
September	Unit 2	Chemical Bonding and Molecular Structure ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Haber cycle and its applications, polarizing power and polarizability. Fajans rules.
October	Unit 2	Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.
November	Unit 2	MO Approach: Bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, Molecular orbital diagram of homonuclear diatomic molecules (N_2 ; O_2) and heteronuclear diatomic molecules (CO, NO).

Department of Chemistry

Session 2021-22

LESSON PLAN

Class -BSc I Semester

Subject -Industrial Aspects of organic & inorganic chemistry

Month	Unit	Topic
July	Unit 1	Chemical bonding, hybridization, classification of organic compounds, IUPAC
August	Unit 1	Geometry of molecule, cleavage of bonds, types of reagents.
September	Unit 2	types of reactions, oxidation, reduction, addition reaction, elimination reaction, substitution reaction,
October	Unit 2	aromatic electrophonic substitution reaction Classification of elements, Morden periodic table,
November	Unit 2	periodicity of elements, redox reaction

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -BSc II Semester

Subject -chemistry of s,p & d block elements ,state of matter &Chemical Kinetics

Month	Unit	Topic
January	Unit 4	Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices.
February	Unit 4	Miller indices. X Ray diffraction by crystals, Braggs law. Structures of NaCl, and CsCl (qualitative treatment only). Defects in crystals. Chemical Kinetics
March	Unit 4	Chemical Kinetics The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction.
April	Unit 4	Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of a concept of activation energy and its calculation from Arrhenius equation

Department of Chemistry

Session 2022-23

LESSON PLAN

Class- BSc II Semester

Subject -Industrial chemistry

January	Unit 1	Evaporation - Introduction, Equipment's short tube (standard) evaporator, forced circulation evaporators, falling film evaporators, climbing film (Upward flow) evaporators, wiped (agitated) film evaporators
February	Unit 1	Filtration- Introduction, filter media and filter aids
March	Unit 2	equipment's - plate and frame, filter Press, notch filter, rotatory drum filter, sparkler filter, candle filter, bag filter, and centrifuge.
April	Unit 2	Drying - Introduction, free moisture, bound moisture, drying curve, Equipment's, tray dryer, flash dryer, fluid bed dryer, drum dryer, spray dryer.

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -BSc III

Subject -organic chemistry

MONTH	UNIT	TOPICS
July	Unit - 1	Organometallic Compounds Organ magnesium compounds: The Grignard Reagents- formation, structure and chemical reactions Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions. B. Organ Sulphur Compound Nomenclature, structural features, methods of formation and chemical reactions of thiols; thioethers, sulphonic acids, sulphonamides and sulphaguanidine. C. Organic Synthesis via Enolates Active methylene group alkylation of diethyl malonate and ethyl acetoacetate, Synthesis of ethyl acetoacetate; the Claisen Condensation. Keto-enol tautomerism of ethyl acetoacetate.
August	Unit - 2	BIOMOLECULES A Carbohydrates Configuration of monosaccharides. Erythro and threo diastereomers. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D (+)- glucose. Structure of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose, and lactose) and polysaccharides (starch and cellulose) without involving structure determination. B Protein and nucleic acid: Classification and structure of proteins, levels of protein structure, protein denaturation/renaturation, constituents of amino acid, ribonucleosides and ribonucleotides and double helical structure of DNA
September	Unit-3	Synthetic polymers Addition or chain-growth polymerization. Free radical vinyl polymerization, Ziegler-Natta

October		<p>polymerization. Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.</p> <p>B. Synthetic Dyes Colour and constitution (electronic concept). Classification of dyes. Chemistry of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.</p>
November	Unit -4	<p>Spectroscopy-I A Mass spectroscopy: Mass spectrum, fragmentation of functional group. B Infrared spectroscopy: IR absorption band, their position and intensity, identification of IR spectra. C UV/Visible spectroscopy: Beer-Lambert law, effect of conjugation. λ_{max}, visible spectrum and color Anthocyanin as natural coloring matter(introduction only) Application of Mass; Infrared spectroscopy, Ultraviolet spectroscopy to organic molecules</p>
December	Unit -5	<p>Spectroscopy-II: A NMR Spectroscopy: Introduction to NMR, shielding and number of signals in PMR, chemical shift and characteristics value, splitting of signals and coupling constants, application of Inorganic molecules.</p>
January	Unit 5	<p>A 13 CMR spectroscopy: Principle and applications. B Magnetic resonance imaging(MRI): Introductory idea</p>

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -MSc I Semester

Paper II (Reaction Mechanism)

MONTH	UNIT	TOPICS
AUGUST	Unit -1	Addition to carbon – carbon multiple bonds Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals
SEPTEMBER	Unit-2	Addition to carbon – carbon multiple bonds Regio- and chemo selectivity, orientation and reactivity. Hydrogenation of aromatic rings, hydrogenation of double and triple bonds.
OCTUBER	Unit-3	Addition to Carbon-Hetero multiple bonds Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds. Acids, esters and nitriles
NOVEMBER	Unit-4	Addition of Grignard reagent, organo zinc and organo lithium reagents to carbonyl and unsaturated carbonyl compounds, Wittig reaction. Mechanism of condensation reaction involving enolates – Claisen, Mannish, Benzoin, Perkin and Stobbe reactions.

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -MSc II Semester

Paper II BIOMOLECULES AND STEREOCHEMISTRY

MONTH	UNIT	TOPICS
January	Unit -1	. Carbohydrates Structural polysaccharides, cellulose and chitin, storage polysaccharides starch and glycogen, structure and biological functions of glycosaminoglycans. or mucopolysaccharides. Carbohydrates of glycoproteins, and glycolipids. Role of sugars in biological recognition. Blood group substances.
February	Unit-1	Carbohydrate metabolism - Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, pentose phosphate pathway. Lipids
March	Unit-3	Lipids Fatty acids, essential fatty acid's structure and function of triacylglycerols, glycerenholipids, sphingolipids cholesterol, bile acids, prostaglandins.
April	Unit-4	. Lipoproteins- composition and function, role in atherosclerosis. Properties of lipid of aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes, Fluid mosaic model of membrane structure. Lipid metabolism, oxidation of fatty acids.

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -MSc III Semester

Paper II (Biochemistry) & Paper III (Organ transition metal complexes)

MONTH	UNIT	TOPICS
JULY AND AUGUST	Unit -1	Bioorganic Chemistry Enzymes Chemical & Biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Fisher's lock & key and koshland's induced fit theory, identification and labeling, Enzyme kinetics, Michaelis- Menten and Lineweaver-Burk plots, reversible & irreversible inhibition..
SEPTEMBER	Unit-2	Mechanism of Enzyme Action Transition state theory, orientation & steric effect, acid - base catalysis. Covalent catalysis, strain or distortion complexes of some typical enzyme, mechanism for lysozyme & carboxypeptidase A.
OCTUBER	Unit-3	Stoichiometric reaction for catalysis, homogenous catalysis, hydrogenation, Ziegler-Natta polymerization of olefins
NOVEMBER	Unit-4	catalytic reaction involving carbon monoxide such as hydro carbonylation of olefin (oxo reaction), oxypalladation reaction activation of C-H bonds.

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -MSc VI Semester

Paper 1 PHOTOCHEMISTRY AND SOLID STATE

MONTH	UNIT	TOPICS
January	Unit -1	A. Solid state chemistry General principles, experiment procedures, co-precipitation as a precursor to solid state reaction, kinetics of solid chemistry.
February	Unit-1	B. Crystal defects and non-stoichiometry - Perfect & imperfect crystal, intrinsic defects- point defects, line & plane defects. Thermodynamics of Schottky & Frenkel defects formation. Color centers, non-stoichiometry & defects.
March	Unit-2	Electronic properties & band theory- Metal, insulators & semiconductors, electronic structure of solid- band theory, bond structure of metals, insulators semiconductors, intrinsic & extrinsic semiconductors doping semiconductors, p-n junction, superconductors.
April	Unit-2	Photoconduction- photoelectric effects- Quantum theory of paramagnetic- domains, hysteresis's.

TEACHING PLAN (2022-23)

Dr. Priyanka Singh

B.Sc. I Sem

DSC-Chemistry (FUNDAMENTAL INORGANIC & ORGANIC CHEMISTRY)

Session : 2022-23

S. No.	Month	Topics
1	August	Atomic Structure Review of: Bohrs theory and its limitations, dual behaviour of matter and radiation, de-Broglies relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom.
2	September	Radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.
3	October	Chemical Bonding and Molecular Structure Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Land equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajans rules, ionic character in covalent compounds, dipole moment and percentage ionic character. Covalent bonding:
4	November	VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, Molecular orbital diagram of homonuclear diatomic molecules (N_2 ; O_2) and heteronuclear diatomic molecules (CO, NO). Comparison of VB and MO approaches.

P. Singh

Dr. Priyanka Singh

B.Sc. I Sem

GE-Industrial Chemistry (FUNDAMENTAL INORGANIC & ORGANIC CHEMISTRY)

Session : 2022-23

S. No.	Month	Topics
1	August	1. Nomenclature, generic names, trade names 2. Raw material for organic compounds: Petroleum, natural gas, fractional distillation of crude oil
2	September	1. Petroleum: Cracking, reforming, hydroforming, isomerisation 2. Coal: Types, Structure, Properties, distillation of coal, chemicals derived from coal
3	October	1. Renewable natural resources: cellulose, starch, properties, modification, important industrial chemicals derived from them, Alcohol and alcohol based chemicals, oxalic acid, Furfural. 2. Basic metallurgical operations: pulverization, calcination, roasting and refining
4	November	Physico chemical principles of extraction of Iron, Copper, Lead, Silver, Sodium, Aluminium, Magnesium, Zinc, Chromium.

P. Singh

Dr. Priyanka Singh

B.Sc. II Sem

DSC-Chemistry (CHEMISTRY OF s, p & d-BLOCK ELEMENTS, STATES OF MATTER & CHEMICAL KINETICS)

Session : 2022-23

S. No.	Month	Topics
1	January	s- and p-Block Elements Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling & Mulliken scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.
2	February	Compounds of s- and p-Block Elements Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.
3	March	Hydrides of nitrogen (NH_3 ; N_2H_4 ; N_3H ; NH_2OH) Chemistry of elements of transition series Characteristic properties of d-block elements.
4	April	Properties of elements of first, second & third transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry, magnetic behavior, spectral properties and stereochemistry

P. Singh

Dr. Priyanka Singh

B.Sc. II Sem

DSE-Industrial Chemistry (INDUSTRIAL ASPECTS OF PHYSICAL CHEMISTRY, MATERIAL AND ENERGY BALANCE)

Session : 2022-23

S. No.	Month	Topics
1	January	Catalysts: Introduction, Types, Homogeneous and Heterogeneous, Basic principles, Mechanisms, factors affecting the performance. Introduction to phase transfer catalysis.
2	February	Enzyme catalysed reactions - Rate model, industrially important reactions.
3	March	Distillation -Introduction; Batch & continuous distillation, separation of azeotropes, plate columns and packed columns
4	April	Absorption - Introduction, Equipments - Packed columns, spray columns, bubble columns, packed bubble columns, mechanically agitated contractors.



Dr. Priyanka Singh

B.Sc. III Year

Paper - III (Physical Chemistry)

Session : 2022-23

S. No.	Month	Topics
1	August	Quantum Mechanics -I Black-body radiation, Planck's radiation law, photoelectric effect, Compton effect. De Broglie idea of matter waves, Experimental verification of Heisenberg's uncertainty principle, Sinusoidal wave equation, Operator: Hamiltonian operator, angular momentum operator Laplacian operator, postulate of quantum mechanics, eigen values, eigen function, Schrodinger time independent wave equation, physical significance of ψ & ψ^2 , application of Schrodinger wave equation to particle in a one dimensional box, hydrogen atom (separation into three equations) radial and angular wave functions.
2	September	Quantum Mechanics-II Quantum Mechanical approach of Molecular orbital theory, basic ideas-criteria for forming M.O. and A.O., LCAO approximation, formation of H_2^+ ion, calculation of energy levels from wave functions, bonding and antibonding wave functions, Concept of σ , σ^* , π , π^* orbitals and their characteristics, Hybrid orbitals- sp , sp^2 , sp^3 Calculation of coefficients of A.O.'s used in these hybrid orbitals. Introduction to valence bond model of H_2 , comparison of M.O. and V.B. models. Huckel theory, application of Huckel theory to ethene, propene, etc.
3	October	Spectroscopy-I Introduction: Characterization of Electromagnetic radiation, regions of the spectrum, representation of spectra, width and intensity of spectral transition, Rotational Spectrum of calculated Diatomic molecules. Energy levels of a rigid rotor, selection rules, determination of bond length, qualitative description of non-rigid rotator, isotopic effect.
4	November	Vibrational Spectrum: Fundamental vibration and their symmetry vibrating diatomic molecules, Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, determination of force constant, diatomic vibrating operator, anharmonic oscillator Raman spectrum: Concept of polarizability, quantum theory of Raman spectra, stokes and antistokes lines, pure rotational and pure vibrational Raman spectra. Applications of Raman Spectra.
5	December	Electrochemistry-I A. Electrolytic conductance: Specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law in determination of dissociation constant of weak electrolyte, solubility

		of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations.
6	January	<p>B. Theories of strong electrolyte: limitations of Ostwald's dilution law, weak and strong electrolytes, Debye-Huckel-Onsager's equation for strong electrolytes, relaxation and electrophoretic effects</p> <p>C. Migration of ions: Transport number, definition and determination by Hittorf method and moving boundary method.</p>
7	February	<p>Electrochemistry-II</p> <p>A. Electrochemical cell and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells, EMF of the cell and effect of temperature on EMF of the cell, Nernst equation Calculation of ΔG, ΔH and ΔS for cell reactions.</p> <p>B. Single electrode potential : standard hydrogen electrode, calomel electrode, quinhydrone electrode, redox electrodes, electrochemical series,</p> <p>C. Concentration cell with and without transport, liquid - junction potential, application of concentration cells in determining of valency of ions, solubility product and activity coefficient .</p> <p>D. Determination of pH and pKa, using hydrogen and quinhydrone electrodes potentiometric titration. Buffer solution, Henderson-Hasselbalch equation, hydrolysis of salts, Corrosion-types, theories and prevention.</p>

P. Singh

Dr. Priyanka Singh

M.Sc. I SEM

PAPER- III : MATHEMATICS FOR CHEMISTS, QUANTUM CHEMISTRY AND CHEMICAL DYNAMICS

Session : 2022-23

S. No.	Month	Topics
1	August	Unit-II Quantum Chemistry Time-independent Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz. particle in one dimensional and three dimensional box, concept of degeneracy, the harmonic oscillator, the rigid rotor, the hydrogen atom.
2	September	Angular Momentum Ordinary angular momentum, eigen functions and eigen values of angular momentum, ladder operator, concept of spin, antisymmetry and Pauli's exclusion principle.
3	October	Unit-III Approximate Methods The variation theorem and perturbation theory (first order and non degenerate). Applications of variation method and perturbation theory to hydrogen and helium atom.
4	November	Electronic Structure of Atoms Russell-Saunders terms and coupling schemes. Atomic states, atomic terms and term symbols. Molecular Orbital Theory Huckel theory of conjugated systems, Applications to ethylene, butadiene and cyclobutadiene.

P. Singh

Dr. Priyanka Singh

M.Sc. II SEM

PAPER- III : SPECTROSCOPY

Session : 2022-23

S. No.	Month	Topics
1	January	Unit – I Molecular Spectroscopy Energy levels, molecular orbital, vibronic transitions, vibration 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 complex, charge transfer spectra.
2	February	Microwave Spectroscopy Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications.
3	March	Unit –IV Photoelectron Spectroscopy Basic principle: photo-electric effect, ionization process, Koopmans theorem, photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Photo acoustic Spectroscopy Basic principles of photo acoustic spectroscopy (PAS), PAS gases and condensed systems, chemical and surface applications.
4	April	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 McConnell relationship, measurement techniques, applications.



Dr. Priyanka Singh

M.Sc. III SEM

Paper - I CHROMATOGRAPHIC TECHNIQUES AND APPLICATIONS OF SPECTROSCOPY

PAPER- II BIOCHEMISTRY

Session : 2022-23

S. No.	Month	Topics
1	August	Unit - I Chromatographic Techniques Introduction, classification of chromatographic methods Basic principles and applications of partition chromatography, paper chromatography, column chromatography, high performance liquid chromatography, thin layer chromatography and gas chromatography.
2	September	Mossbauer Spectroscopy – Basic principle spectroscopy parameters and spectrum display , application of the technique to the studies of (i) bonding & structures of Fe ²⁺ and Fe ⁺³ compounds including those of intermediate spin detection of oxidation state & inequivalent MB atoms.
3	October	Unit – IV Biophysical Chemistry Bioenergetics- Standard free energy change in biochemical reaction, exergonic and endergonic reaction, hydrolysis of ATP, synthesis of ATP from ADP. Thermodynamics of Biopolymer Solutions Thermodynamics of biopolymer solutions osmotic pressure, membrane equilibrium, muscular contraction & energy generation in mechanochemical system.
4	November	Transport of ions Ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport, nerve conduction. Biopolymers & their molecular weights Evaluation of size, shape molecular weight and extent of hydration of biopolymers by various experimental techniques like sedimentation and viscosity electrophoresis.

P. Singh

Dr. Priyanka Singh

M.Sc. IV SEM

Paper - II ENVIRONMENTAL CHEMISTRY

PAPER- IV Elective - A

CHEMISTRY OF MATERIALS & RADIOCHEMISTRY

Session : 2022-23

S. No.	Month	Topics
1	January	Unit - III Atmosphere chemical composition of atmosphere, chemical and photochemical reaction in atmosphere, smog formation, oxides of Nox and their effect, pollution by chemicals,
2	February	VOC'S chloroflouro hydro carbons. Green house effect, acid rain, air pollution controls
3	March	Unit - III Principle and application of TGA, DTA, & DSC.
4	April	Polarimetry, Optical Rotatory Dispersion and Circular Dichroism Introduction, polarized light, optical activity, application of polarimetry, ORD and CD, rotator dispersion, instrumentation, cotton effect, anomalous ORD curves, relationship between ORD and CD, Axial haloketone rule, the octant rule, applications of octant rule, applications of ORD and CD, advantages of CD over ORD, limitations of ORD and CD.

P. Singh



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Department of Chemistry

Session 2022-23

LESSON PLAN

Class –BSc-I Semester

Subject – Fundamental of inorganic and organic chemistry

Month	Unit	Topic
July	Unit 1	Review of: Bohr's theory and its limitations, dual behavior of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s
August	Unit 1	Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (M_S). Rules for filling electrons in various orbitals, electronic configurations of the atoms. Stability of half-filled and filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.
September	Unit 2	Chemical Bonding and Molecular Structure ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born- Haber cycle and its applications, polarizing power and polarizability. Fajans rules.
October	Unit 2	Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.
November	Unit 2	MO Approach: Bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, Molecular orbital diagram of homonuclear diatomic molecules (N_2 ; O_2) and heteronuclear diatomic molecules (CO, NO).

Department of Chemistry

Session 2021-22

LESSON PLAN

Class -BSc I Semester

Subject -Industrial Aspects of organic & inorganic chemistry

Month	Unit	Topic
July	Unit 1	Renewable natural resources: cellulose, starch, properties, modification
August	Unit 1	Important industrial chemicals derived from them, Alcohol and alcohol based chemicals oxalic acid, Furfural
September	Unit 2	Oxalic acid, Furfural, Alcohols
October	Unit 2	Basic metallurgical operations: pulverization
November	Unit 2	Calcination, roasting and refining

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -BSc II Semester

**Subject -Chemistry of s,p & d block elements, state
of matter & Chemical Kinetics**

Month	Unit	Topic
January	Unit 4	Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices.
February	Unit 4	Miller indices. X Ray diffraction by crystals, Braggs law. Structures of NaCl, and CsCl (qualitative treatment only). Defects in crystals. Chemical Kinetics
March	Unit 4	Chemical Kinetics The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction.
April	Unit 4	Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of a concept of activation energy and its calculation from Arrhenius equation

Department of Chemistry

Session 2022-23

LESSON PLAN

Class- BSc II Semester

Subject -Industrial chemistry

January	Unit 1	1. Fluid Flow: Fans, blowers, compressors, vacuum pumps, ejector.
February	Unit 1	2. Pumps: Reciprocating pumps, Gear pumps, centrifugal Pumps.
March	Unit 2	3. Heat Exchangers: Shell and tube type, finned tube heat exchangers, plate heat exchangers, refrigeration cycles.
April	Unit 2	4. first law of thermodynamics, enthalpy of reaction, Hess law, exothermic and endothermic reactions

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -BSc III

Subject –Inorganic
chemistry

MONTH	UNIT	TOPICS
July	Unit -1	<p>(A) Limitations of valence bond theory, Limitation of Crystal Field Theory, Application of CFSE, tetragonal distortions from octahedral geometry, Jahn–Teller distortion, square planar geometry. Qualitative aspect of Ligand field and MO Theory.</p> <p>(B) Thermodynamic and kinetic aspects of metal complexes. A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes, Trans- effect, theories of trans effect. Mechanism of substitution reactions of square planar complexes.</p>
August	Unit -2	<p>MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES</p> <p>Types of magnetic behavior, methods of determining magnetic susceptibility, spin only formula, L-S coupling, correlation of μ_{so} (spin only) and μ_{eff}. values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes. Electronic spectra of Transition Metal Complexes. Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectro-chemical series. Orgel-energy level diagram for d1 and d2 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.</p>
September	Unit-3	<p>ORGANOMETALLIC CHEMISTRY</p> <p>Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18-electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series.</p> <p>Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co acceptor behavior of CO (MO diagram of CO to be discussed), Zeise structure.</p>

October	Unit 3	Catalysis by Organometallic Compounds – Study of the following industrial processes and their mechanism : 1. Alkene hydrogenation (Wilkinsons Catalyst) 2. Polymeration of ethane using Ziegler – Natta Catalyst
November	Unit -4	Bioinorganic chemistry Essential and trace elements in biological processes, Excess and deficiency of some trace metals, Toxicity of some metal ions (Hg, Pb, Cd and As), metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Ca^{2+} and Mg^{2+} , nitrogen fixation.
December	Unit -5	HARD AND SOFT ACIDS AND BASES (HSAB) Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, Applications of HSAB principle.
January	Unit 5	Inorganic Polymers Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones. Silicates, phosphazenes and polyphosphate.

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -MSc I Semester

Paper-I (CO-ORDINATION CHEMISTRY)

MONTH	UNIT	TOPICS
August	Unit -1	Unit - I Theories of Chemical Bonding in Co-ordination Chemistry Basic knowledge of VBT, CFT, VSEPR, Walsh diagrams (tri- and penta- atomic molecules), $d\pi - p\pi$ bonds
September	Unit-2	Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. Jahn-Teller distortion, causes of distortion
October	Unit-3	Metal π-Ligand Bonding Limitation of and applications of valence bond theory, crystal field theory, ligand field theory, molecular orbital theory
November	Unit-4	Octahedral, tetrahedral and square planar complexes, π - bonding and molecular orbital theory.

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -MSc I Semester

Paper II (BIOMOLECULES AND STEREOCHEMISTRY)

MONTH	UNIT	TOPICS
August	Unit -1	Fundamental concepts of organic reactions Electronic effects in organic molecules; inductive effective, electrometric effect, hyperconjugation, resonance, mesomeric/resonating effect, tautomerism, Conjugation in organic compounds, bonding in Fullerenes, bonds weaker than covalent, addition compounds.
September	Unit-1	Stereochemistry Elements of symmetry, chirality, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis using chiral reagent, chiral catalysts, chiral auxiliary and chiral substrates (<i>Felkin-Anh</i> model and <i>Cram's</i> rule)
October	Unit-3	Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.
November	Unit-4	Conformational analysis Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -MSc II Semester
PAPER- IV (Spectroscopy)

MONTH	UNIT	TOPICS
January	Unit -3	Unit – III Nuclear Magnetic Resonance Spectroscopy Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei
February	Unit-3	Chemical shift and its measurements, factors influencing chemical shift, deshielding, spin- spin interactions , factors including coupling constant 'J'
March	Unit-3	Classification (ABX, AMX, ABC, A2B2, etc), spin decoupling. Basic ideas about instruments, FT NMR, advantages of FT NMR, use of NMR in medical diagnostics.
April	Unit-3	Nuclear Quadruple Resonance Spectroscopy Quadruple nuclei, Quadruple moments, electric field gradient, coupling constant, splitting, applications.

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -MSc III Semester

Paper - I (Chromatographic Techniques and Applications of Spectroscopy)

MONTH	UNIT	TOPICS
July and August	Unit -3	Unit - III Nuclear Magnetic Resonance Spectroscopy- General introduction and Definition , chemical shift , spin-spin interaction , shielding mechanism of measurement , chemical shift value and correlation for protons bonding to carbon .
September	Unit-3	(aliphatic, olefinic, aldehydic & aromatic and other nucleic alcohols, phenols, enols, carboxylic acids amines, amides and mercapto), chemical exchange, effect of deuteration complex, spin-spin interaction between two three (first other spectra) virtual coupling, stereochemistry
October	Unit-3	Hindered rotation, simplification of complex spectra nuclear magnetic double resonance, contact shift reagent solvent effect, fourier transform technique nuclear overhousear effect (NOE), resonance of other nuclei –F, P.
November	Unit-3	Nuclear Magnetic Resonance of Paramagnetic Substances in Solution- The contact and pseudo contact shifts, factors affecting nuclear relaxations. Some applications including biochemical systems.

Department of Chemistry

Session 2022-23

LESSON PLAN

Class -MSc III Semester

PAPER- II (BIOCHEMISTRY)

MONTH	UNIT	TOPICS
July and August	Unit 1	Bioinorganic Chemistry Metal ion in biological system Essential and trace metals Na^+/K^+ pumps, Role of metal ion in biological process.
September	Unit 1	Bioenergetic and ATP cycle Metal complexes in transmission of energy, chlorophylls, photosynthesis and photosystem in cleavage of water.
October	Unit 1	Electron transfer in Biology Electron transport process-cytochromes & iron sulphur proteins. Transport and Storage of Dioxygen Heme proteins and oxygen uptake, structure and function of Haemoglobin, myoglobin
November	Unit 1	Chemocyanin and chemerythrin, Model synthetic complex of iron, cobalt, copper. Nitrogenous base Biological nitrogen fixation , molybdenum nitrogenase.

Department of Chemistry

Session 2022-23

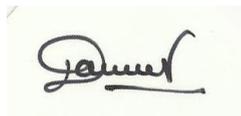
LESSON PLAN

Class -MSc IV Semester

PAPER- IV Elective - A

PAPER- II (CHEMISTRY OF MATERIALS & RADIOCHEMISTRY)

MONTH	UNIT	TOPICS
January	Unit 2	Composites Introduction, Classifications, Binary and ternary composites based on metals, metal oxides, polymers
February	Unit 2	Carbon allotropes and their energy storage, biomedical and environmental radiation applications.
March	Unit 2	Nanomaterials Fundamental aspects, preparation methods, Characterization techniques-FTIR, UV-Vis, SEM, EDS, XPS and TEM,
April	Unit 2	Their application towards antimicrobial, antifungal, anticancer, dyes remediation, environmental radiation applications.



Dr Dakeshwar Kumar Verma
Assistant Professor
Dept of Chemistry
Govt. Digvijay Auto. PG College
Rajnandgaon