2023-24

Department of Chemistry

Govt P G College Berinag

Teaching Plan

Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

B.Sc. I Semester (NEP)

Semester-I
Paper-I (Theory)
Course Title: Fundamentals of Chemistry-I

Programme/Class: Certificate in Introductory Chemistry	**Year:** First	**Semester:** First
		Paper-I Theory Subject: Chemistry
Course Code:	**Course Title:** Fundamentals of Chemistry-I	

Course outcomes: There is nothing more fundamental to chemistry than the chemical bond. Chemical bonding is the language of logic for chemists. Chemical bonding enables scientists to take the 100-plus elements of the periodic table and combine them in myriad ways to form chemical compounds and materials. Periodic trends, arising from the arrangement of the periodic table, provide chemists with an invaluable tool to quickly predict an element's properties. These trends exist because of the similar atomic structureof the elements within their respective group families or periods, and because of the periodic nature of the elements. Reaction mechanism gives the fundamental knowledge of carrying out an organic reaction in a step-by-step manner. This course will provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective. Students will gain an understanding of;

- ✓ Molecular geometries, physical and chemical properties of the molecules.
- ✓ Current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters.
- ✓ This course gives a broader theoretical picture in multiple stages in an overall chemical reaction.
- ✓ It describes reactive intermediates, transition states and states of all the bonds broken and formed.
- ✓ It enables to understand the reactants, catalyst, stereochemistry and major and minor products of any organic reaction. It describes the types of reactions and the kinetic and thermodynamic aspects one should know for carrying out any reaction and the ways how the reaction mechanism can be determined. ·
- ✓ The chapter stereochemistry gives the clear picture of two-dimensional and three-dimensional structure of the molecules, and their role in reaction mechanism. Thecourse will also strengthen the knowledge of students regarding complete picture of states of matter that includes gaseous, liquid, solid and colloidal states.

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ASSISTANT PROFESSOR
(CHEMISTRY)
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Credits:4	Compulsory
Max. Marks: 25+75	Min. Passing Marks:.....

Total Number of Hours = 60

Unit	Content	Number of Hours
1	**Atomic Structure and Periodic Properties:** Dual nature of matter; de Broglie concept. Heisenberg uncertainty principle; itssignificance. Atomic orbitals, Schrödinger wave equation (no derivation); significance of ψ and ψ^2. Quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p and d orbitals. Aufbau energy diagram, Pauli's exclusion principle. Hund's rule of maximum multiplicity. Electronic configuration of elements (s block, p block and firstseries of d-block elements). Effective nuclear charge, Slater's rule. The general idea of Modern periodic table, atomic and ionic radii, ionization potential, electron affinity, electronegativity-definition, trends of variation in periodic table and their application in prediction and explaining the chemical behaviour of elements and compounds thereof.	12 MR. BHUPENDRA BISHT
2	**Chemical Bonding-I**: Ionic bond, covalent bond-Valence Bond Theory and its limitations; various types of hybridization and shapes of different inorganic and organic molecules. Valence Shell Electron Pair Repulsion Theory (VSEPR) and shapes of NH_3, H_2O, H_3O^+, SF_4, ClF_3, ICl_2^-, TeF_5^- NH_4^+ and other simple molecules/ions (CO_2, SO_2, SO_3, Cl_2O_7, SO^{2-}, CO_3^{2-}, NO_3^-, PO_4^{3-}) including compounds of xenon. Resonance, hyperconjugation, field effects- inductive, mesomeric, electromeric effect	8 MR. BHUPENDRA BISHT
3	**Mechanism of Organic Reactions:** Types of reagents- electrophiles and nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediates- carbocations,carbanions, free radicals, carbenes, arynes and nitrenes (with examples).	8 DR. B.S. BISHT
4	**Stereochemistry of Organic Compounds:** Types of isomerism- optical isomerism- elements of symmetry, molecular chirality, enantiomers, stereogenic centers, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centre, diastereomers, threo and erythro diastereomers, meso compounds, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometrical isomerism: determination of configuration of geometrical isomers, E & Z system of	12 DR. B.S. BISHT

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	nomenclature.	
5	**States of Matter-I: Gaseous State-**Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waal's equation of states, Critical phenomena – PV isotherms of real gases, relationship between critical constants and van der Waals constants. Molecular velocities: Root mean square, average and most probable velocities, qualitative discussion of the Maxwell's distribution of molecular velocities, Numerical problems. **Liquid State-**Intermolecular forces, Structural differences between solids, liquids and gases. Physical properties of liquidsincluding their methods of determination: surface tension, viscosity, Numerical problems.	**12** DR. B.S. BISHT
6	**States of Matter-II:** **Solid State:** Introduction to crystalline materials, Definition of space lattice, unit cell, crystal planes, Miller indices, Laws of crystallography – (i) law of constancy of interfacial angles (ii) law of rationality of indices (iii) law of symmetry. Symmetry elements in crystals, X-ray diffraction by crystals. Bragg's equation, Numerical problems. **Colloidal State:** Definition of colloids, classification of colloids. Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number.	**8** MR. BHUPENDRA BISHT

Semester-II
Paper-I
(Theory)
Course Title: Fundamentals of Chemistry-II

Programme/Class: Certificate in Introductory Chemistry	**Year:** First	**Semester:** Second
		Paper-I Theory Subject: Chemistry
Course Code:	**Course Title:** Fundamentals of Chemistry-II	

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Course outcomes: Upon successful completion of this course, the students will be able to describe the reactions shown by aliphatic and aromatic compounds. They will also able to understand the bonding in inorganic molecules, salient features of s- and p- block elements, different aspects of chemical kinetics, catalysis and first law of thermodynamics.

Credits: 4	**Compulsory**	
Max. Marks: 25+75		
Total Number of Hours = 60		
Units	**Content**	**Number of Hours**
1	**Chemical Bonding-II:** Molecular Orbital Theory (MOT) as applied to diatomic homonuclear/heteronuclear inorganic molecules. MO diagrams and bond order of H_2, He_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, Ne_2, CO, NO, HF difference between VB and MO theories. Multicentre bonding in electron deficient molecules. Polarization of covalent molecules, Percentage ionic character from dipole and electronegativity difference. Polarizing power and polarizability; Fajan's rule. Metallic bond- Electron Pool, valence bond and MO theories. Weak interactions-hydrogen bonding in inorganic and organic molecules and van der Waals interactions.	**10** MR. BHUPENDRA BISHT
2	**Salient Features of s- and p-Block Elements:** General discussion with respect to all periodic (Occurrence, electronic configuration, atomic & ionic radii, density, ionization potential, metallic behaviour, electropositive nature, electronegativity, electron affinity, hydration energy, flame colouration, photoelectric effect, polarization power, boiling and melting point) and chemical properties (reactivity towards water, oxygen, air and moisture, hydrogen, halogens, ammonia). Diagonal relationship, catenation, inert pair effect, pπ- pπ, dπ-pπ bond, chemistry of hydrides, halides, oxides and oxyacids of p-block elements. Silicates, Boron nitrogen compounds (borazene and boron nitrides), interhalogen compounds, basic property of iodine.	**10** MR. BHUPENDRA BISHT

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3	**Aliphatic Compounds:** Chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes. Cycloalkanes- Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring-bent or banana bonds. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's Rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applicationsof ethylene and propene. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal- ammonia reduction, oxidation and polymerization.	**10** DR. B.S. BISHT
4	**Aromatic Compounds:** Aromaticity- the Hückel rule, aromatic ions. Aromatic electrophilic substitution- general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel- Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactionsof benzene derivatives.	**10** DR. B.S. BISHT
5	**Chemical Kinetics and Catalysis:** Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction– concentration, temperature, pressure, solvent, light, catalyst; hetero and homocatalysis, significance. Inhibitors, poisons and promoters. Concentration dependence of rates of simple reaction, Molecularity, Order of reaction- zero order, first order, second order, pseudo-order, Radioactive decay a first order phenomenon, half-life period, Methods of determination of the order of reaction- differential method, method of integration, method of half-life period and isolation methods, Numerical problems.	**10** MR. BHUPENDRA BISHT
6	**Thermodynamics I:** Definition of thermodynamic terms, system, surroundings etc. Types of thermodynamic systems and thermodynamic processes. Intensive and extensive properties. Concept of heat and work, first law of thermodynamics, definition of internal energy and enthalpy. Heat capacity – heat capacities at constant volume and at constant pressure and their relationship, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and reversible conditions. Thermochemistry; standard state, Standard enthalpy of formation – Hess's law of heat summation and its application. Temperature dependence ofenthalpy, Kirchoff's equation, Numerical problems.	**10** DR. B.S. BISHT

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Teaching Plan

Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

Semester-III
Paper-I
(Theory)
Course Title: General Chemistry-I

Programme/Class: Diploma in Chemical Science	**Year:** Second	**Semester:** Third
Paper-I Theory Subject: Chemistry		
Course Code:	**Course Title:** General Chemistry-II	

Course outcomes: This paper provides detailed knowledge of synthesis of various classes of organic compounds and functional groups inter conversion. Organic synthesisis the most important branch of organic chemistry which provides jobs in production & QC departments related to chemicals, drugs, medicines, FMCG etc. industries.

- ✓ It relates and gives an analytical aptitude for synthesizing various industrially important compounds.
- ✓ This paper also provides a detailed knowledge on the elements present in our

surroundings, their occurrence in nature. Their position in periodic table, their physical and chemical properties. This paper also gives detailed understanding of the d-block elements and their characteristics.

- ✓ After successful completion of this course, the students will be able to gather the information regarding Werner's theory and VBT of transition metal complexes.
- ✓ Students will be able to learn the basic concepts of spontaneity, chemical and phase equilibrium and able to apply these concepts in predicting the spontaneous reactions and will be able to solve the numerical problems based on these concepts.

Credit: 4	**Compulsory**
Max. Marks: 25+75	
Total No. of Hours- = 60	

Unit	Contents	Number of Hours

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1	**Chemistry of Transition Elements (First, second and third Transition Series):** Characteristic properties of the elements; electronic configuration, atomic & ionic radii, oxidation states and stability of uncommon oxidation states, ionization energy, boiling & melting points, complex compound formation, colour, catalytic properties and magnetic properties. coordination number and geometry. Comparative treatment of 3d, 4d and 5d elements and their analogues in respect of occurrence, atomic & ionic radii, oxidation state, ionization energy, complex formation tendency, magnetic behaviour, geometry and colour.	10
2	**Coordination Chemistry-I:** Definition, terminology (ligand, coordination number, coordination sphere, complex ion etc.), Nomenclature of coordination compounds (IUPAC system), Werner's theory for coordination compounds; its experimental verification, effective atomic number (EAN) concept, 18-electron rule, stability of complexes and factors contributing to the stability. Chelates- Introduction, factors affecting the stability of chelates, thermodynamic origin of stability, applications. Valence Bond Theory (VBT) for coordination compounds, geometry of complexes (tetrahedral, octahedral, square planar), magnetic properties of complex compounds.	10
3	**Halides:** Chemical reactions. Alkyl, aryl and vinyl halides. Mechanism of nucleophilic substitution reactions, S_N2 and S_N1 reactions with energy profile diagrams.	8
4	**Alcohols and Phenols:** Alcohols: Reactions of alcohols. Dihydric alcohols-methods of preparation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol.	12

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	Phenols: Physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution, acylation and carboxylation. Mechanism of Fries rearrangement, Claisen condensation, Gatterman synthesis, Houben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.	
5	**Thermodynamics II:** Second law of thermodynamics, need of the law, different statements of the law. Carnot cycle and itsefficiency, Carnot theorem. Thermodynamic scale of temperature. Concept of entropy: entropy as a state function, entropy as a function of V and T, entropy as a function of P and T, entropy change in physical and chemical processes, entropy change for reversible, irreversible and equilibrium condition. Clausius inequality, entropy as criteria of spontaneity and equilibrium. Entropy change in ideal gases. Gibbs free energy and Helmholtz work functions. Criteria for thermodynamic equilibrium and spontaneity, advantage Gibbs free energy and Helmholtz work functions over entropy change for spontaneity. Variation of G andA with P, V and T, Gibbs-Helmholtz equation, Numerical problems.	12
6	**Chemical Equilibrium:** The law of mass action, free energy and equilibrium constant, factors influencing equilibrium constant, relationship between Kp and Kc. Le-Chatelier's principle, Numerical problems. **Phase Equilibrium:** Statement and meaning of the terms: phase, component and degree of freedom, Gibbs phase rule, phase equilibria of one component systems- water, carbon dioxide and sulphur. Raoult's and Henry's law.	8

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Semester-IV Paper-I
(Theory)
Course Title: General Chemistry-II

Programme/Class: Diploma in Chemical Science	Year: Second	Semester: Fourth
	Paper-I Theory Subject: Chemistry	
Course Code:	Course Title: General Chemistry-II	

Course outcomes: This paper provides detailed knowledge of synthesis of aldehydes, ketones, carboxylic acids and functional groups inter conversion. The students will be able to describe the concepts of electrochemistry in detail and its applications. Also, they will be able to solve the numerical problems based on these concepts. Students will be able to define the acids and bases on the basis of various concepts/ theories and will be able to identify the position of various elements in the periodic table and able to explain their properties on thebasis of their position.

Credits: 4	Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Hours- = 60

Unit	Contents	Number of Hours
1	**Acids and Bases:** Arrhenius concept, Bronsted-Lowry concept, Lux-Flood and Lewis concept of acids and bases; Hard and Soft Acid-Base Theory: Classification of acids and bases as hard and soft. Pearson's hard and soft acid base concept, acid base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness; Role ofthe solvent and strength of acids and bases. Acid-base properties in non-aqueous media.	10
2	**Chemistry of Inner Transition Elements:** Chemistry of Lanthanides: Electronic configuration, oxidation states, atomic & ionic radii, lanthanide contraction and its consequences, complex formation, colour; Methods of separation of lanthanides- fractional crystallization, fractional precipitation, change in oxidation state, solvent extraction and ion exchange methods. **Chemistry of Actinides:** General features of actinides-electronic configuration, atomic & ionic radii, ionization potential, oxidation states and complex formation.	10

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3	**Aldehydes and Ketones:** Comparative account of properties of aliphatic and aromatic aldehydes and ketones. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation. Condensation with ammonia and its derivatives; Wittig reaction,Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones. An introduction to α-, β-unsaturated aldehydes and ketones.	10
4	**Carboxylic Acids:** Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides.	10
	Reduction of carboxylic acids, mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids, hydroxy acids- malic, tartaric, and citric acids. Methods ofpreparation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids-methods of preparation and effect of heat and dehydrating agents.	
5	**Electrochemistry I:** Electrical transport-conduction in metals and electrolytic solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Arrheniustheory of electrolytic dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations, Numerical Problems.	8
6	**Electrochemistry II:** Oxidation state, types of redox reactions, balancing of chemical reactions by ion electron and oxidation state method. Computations of equivalent weights. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrode, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K), Numerical Problems.	12

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Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

B.Sc. V Semester (Paper I)-Physical Chemistry

S. No.	Contents	Contact Hours/ Lectures
1	**Thermodynamics II:** Second law of thermodynamics, need of the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature. Concept of entropy: entropy as a state function, entropy change in physical and chemical processes, entropy change in reversible and irreversible processes. Gibbs-Helmholtz equation	12 Lectures
2	**Solutions and Colligative Properties:** Ideal and non-ideal solutions,. Dilute solutions, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular mass determination. Osmosis, law of osmotic pressure, determination ofmolecular mass from osmotic pressure. Elevation of boiling point and depression in freezing point. Abnormal molar mass, degree of dissociation and association of solutes.	8 Lectures
3.	**Photochemistry:** Difference between thermal and photochemical processes. Laws of photochemistry; Grothuss-Drapper law, Lambert's law, Lambert-Beer's law, Stark-Einstein law, Concept of fluorescence, phosphorescence, quantum yield.	8 Lectures
4.	**Energy and Distribution Law:** Degrees of freedom, types of energies in linear and non-linear molecules, Applications of Maxwell-Boltzmann distribution law	6 Lectures
5.	**Thermodynamics III :** Statement and concept of residual entropy, third law of thermodynamics, unattainability of absolute zero, Nernst heat theorem. Evaluation of absolute entropy from heat capacity data	6 lectures

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Teaching Plan

Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

B.Sc. V Semester (Paper I)-Physical Chemistry

S. No.	Contents	Contact Hours/ Lectures
1	**Spectroscopy:** Nuclear magnetic resonance (NMR) spectroscopy; Proton magnetic resonance (1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of pmr spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.	8 Lectures
2	**Carbohydrates: Classification and nomenclature. Monosaccharides, mechanism of osazone formation, inetrconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Cyclic structure of D(+)-glucose. Mechanism of mutarotation.**	7 Lectures
3	**Amino Acids, Peptides, Proteins and Nucleic Acids: Classification, structure and stereochemistry of amino acids. Acid- base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α -amino acids. Nomenclature of peptides and proteins. Peptide structure determination, end group analysis, Protein denaturation/renaturation. Nucleic acids: introduction, constituents of nucleic acids.**	7 Lectures
4	**Fats, Oils and Detergents: Natural fats and common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value and acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.**	6 Lectures
5	**Synthetic Polymers: Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step-growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins. Natural and synthetic rubber.**	6 Lectures
6	**Natural Products: Classification, extraction and general methods of structure determination of terpenoids and alkaloids, chemistry of citral and nicotine.**	5 Lectures

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Teaching Plan

Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

M.Sc. SEMESTER I Paper II

Organic Chemistry-1

S.No.	Contents	Contact Hours/ Lectures
1	**Nature of Bonding in Organic Molecules:** Delocalized chemical bonding conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes, tautomerism. Aromatcity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Hückel's rule, energy level of π - molecular orbitals, annulenes, antiaromaticity, ψ-aromaticity, homo-aromaticity, PMO approach. Bond weaker than covalent bond, addition compounds, crown ether complexes andcryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	6 Lectures
2	**Stereochemistry:** Molecular symmetry and chirality: symmetry operations and symmetry elements, point group classification and symmetry number. Stereoisomerism: Classification, racemic modification, molecules with one, two or more chiral centres. Configuration, nomenclature, D, L, R, S and E, Z nomenclature. Axial and planar chirality and helicity (P & M); stereochemistry and configurations of allenes, spiranes, alkylidene, cycloalkanes, adamantanes, catenanes, biphenyls (atropisomerism), bridged biphenyls, ansa compounds and cyclophanes. Topicity and prostereoisomerism: Topicity of ligands and faces and their nomenclature, stereogenicity, cyclostereoisomerism; configurations, conformations and stability of cyclohexanes, (mono-, di- and tri-substituted), cyclohexenes, cyclohexanones, halocyclohexanones, decalines, decalols, decalones.. Assymetric induction; Cram's, Prelog's and Horeaus rules. Dynamic stereochemistry (cyclic and acyclic). Qualitative correlation between confirmation and reactivity- Curtin-Hammitt principle. Stereochemistry of compounds containing N, S and P. chirogenicity, pseudoasymmetry and stereogeniccentre. Stereoselectivity, stereospecificity, regioselectivity and chemoselectivity. Enantiomeric and diasteriomeric excess.	12 Lectures
3	**PericyclicReactions:** Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-	10 Lectures

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	Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions- conrotatory and disrotatory motions, 4n, 4n+2 and allyl system. Cycloadditions- antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3-dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements- suprafacial and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties, 3,3- and 5,5 sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements. Fluxional tautomerism, Ene reaction.	
4	**Aliphatic Nucleophilic Substitution:** The S_N2, S_N1, mixed S_Ni and S_N2, S_Ni and SET mechanisms. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity. Neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system.	6 Lectures
5	**Aromatic Nucleophilic Substitution:** The S_NAr, S_N1, benzyne and S_Ni mechanism. Reactivity-effect of substrate structure leaving group and attacking nucleophile. The Von-Richter, Sommelet-Hauser and Smiles rearrangements.	6 Lectures
6	**Mechanism of Carbocation Rearrangement Reactions:** Pinacol-Pinacolone rearrangement, Wagner-Meerwein rearrangement, Benzilic acid rearrangement, Allylic rearrangement, Hofman reaction, Schmidt reaction, Baeyer- Villiger oxidation, Cumene-Hydroperoxide rearrangement, Curtius rearrangements, Lossen rearrangement, Dakin reaction. Application of NMR Spectroscopy in detection of carbocations	8 Lectures

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M.Sc. SEMESTER I Paper IV

Group Theory and Instrumentation Chemistry

S.No.	Contents	Contact Hours/ Lectures
1	**Symmetry and Group Theory in Chemistry:** Symmetry elements and symmetry operations, definitions of group and subgroup and their characteristics, relation between orders of and subgroup and their characteristics, relation between orders of a finite group and its subgroup. Conjugacy relation and classes of symmetry operations, point symmetry (or group) and its classification, Schonfliess symbols, representation of group by matrices (representation for the C_n, C_{nv}, C_{nh} etc. groups to be worked out explicity), products of symmetry operations. Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use in spectroscopy.	16 Lectures
2	**X-ray Diffraction Methods:** Bragg condition, Miller indices, Laue's method, Bragg's method, Debye- Scherrer method of X- ray structural analysis of crystals. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules. Ramchandran diagram. General Introduction of Electron Diffraction: Scattering intensity vs scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules.	12 Lectures
3	**Chromatographic methods:** Principle, instrumentation and applications of gas and liquid chromatography. Principle and application of TLC, paper, column and HPLC. Ion Exchange chromatography: Cationic, anionic exchangers and their applications. Gas Chromatography: Theory of gas chromatography, parts of gas chromatograph, detectors (TCD, FID, ECD), Van-Deemter equation (no derivation), concept about HEPT- plate theory and rate theory. Applications.	15 Lectures
4	**Radio Analytical Methods:** Basic principles and types of measuring instrument, isotope dilution techniques- principle of operations and uses. Applications.	5 Lectures

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Teaching Plan

Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

M.Sc. SEMESTER II Paper II

Organic Chemistry-II

S.No.	Contents	Contact Hours/ Lectures
1	**Aliphatic Electrophilic Substitution:** Biomolecular mechanisms- S_E2 and S_E1. The S_E1 mechanism, electrophilic substitution accompanied by double bonds shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity	8 Lectures
2	**Aromatic Electrophilic Substitution:** The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ispo attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling.	8 Lectures
3	**Free Radical Reactions:** Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, autooxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Free radical rearrangements.	8 Lectures
4	**Addition to Carbon-Carbon Multiple Bonds:** Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration..	Lectures
5	**Addition to Carbon-Hetero Multiple Bonds** Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Hydrolysis of esters and amides, ammonolysis of esters.	Lectures

DR. B S BISHT
ASSISTANT PROFESSOR
(CHEMISTRY)
GOVT. PG COLLEGE
BERINAG PITHORAGARH

Department of Chemistry

Govt P G College Berinag

Teaching Plan

Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

	Elimination and Name Reactions: The E2, E1 and E1cB mechanisms and their spectrum. Orientation of the double bond. Reactivity-effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination Vilsmeier reaction, Gattermann-Koch reaction, Sandmeyer reaction, Hunsdiecker reaction, Michael reaction. Sharpless asymmetric epoxidation, Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions, Wittig reaction, Heck reaction, Still reaction, Sonogarishira, Negishi coupling, Grubbs Catalyst.	10 Lectures

Department of Chemistry

Govt P G College Berinag

Teaching Plan

Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

M.Sc. SEMESTER II Paper IV

Spectroscopic Techniques-I

S.No.	Contents	Contact Hours/ Lectures
1	**Electron Spin Resonance Spectroscopy:** Basic Principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Hyperfine coupling isotopic and anisotropic hyperfine	16 Lectures
	coupling constants, spin Hamiltinian, spin densities, measurement techniques, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to inorganic and organic free radicals and to transition metal complexes (having an unpaired electron) including biological systems.	
2	**Nuclear Magnetic Resonance Spectroscopy:** Nuclear Spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing the chemical shift. Deshielding, spin-spin interaction, factors influencing coupling constant (J). Classification (ABX, AMX, ABC, A_2B_2 etc.), spin decoupling, basic idea about instruments, NMR studies of nuclei other than proton; ^{13}C, ^{19}F and ^{31}P. Advantages of FT NMR. Use of NMR in medical diagnostics. Simple problems and interpretation. NOE, simplification of complex spectra by the use of Shift reagent and field strength. Nuclear Overhauser Effect (NOE).^{13}C NMR spectroscopy: general considerations, chemical shift (aliphatic, olefinic, alkyne and aromatic hetero aromatic and carbonyl carbon). Coupling constants.	16 Lectures
3	**Mass Spectrometry:** Introduction, ion production-EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule, example of Mass fragmentation of organic compounds with respect to their structure determination. Problems based on spectroscopic techniques.	16 Lectures

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Teaching Plan

Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

M.Sc. SEMESTER III Paper II

Spectroscope Techniques -2

S.No.	Contents	Contact Hours/ Lectures
1	**Mössbauer Spectroscopy:** Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (i) bonding and structure of Fe^{++} and Fe^{+++} compounds (ii) Sn^{+2} and Sn^{+4} compounds-nature of M-L bond, coordination number, structure and iii) detection of oxidation state and inequivalent MB atoms.	9 Lectures
2	**Ultraviolet and Visible Spectroscopy:** Various electronic transitions (185 to 800 nm), Lambert-Beer's Law, effect of solvent	9 Lectures
	on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, diens, conjugated polyenes. Fieser-Woodward rules for conjugated diens and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds.	
3	**Molecular Dyssemetry and Chiroptical Properties:** Linear and circularly polarized lights, circular birefringence and circular dichroism, ORD and CD curves, Cotton effects. The axial helo ketone rule, Octent diagrams, Helicity and Lowe's Rule. Application of ORD and CD to structural and stereochemical problems	7 Lectures
4	**Infrared Spectroscopy:** Instrumentation and simple handling. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the bond positions and intensities, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines and carbonyl compounds (ketones, aldehydes, esters ,amides, acids anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding, solvent effect on IR of gaseous, solids and polymeric materials. Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond. Strength' anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy, P,Q,R branches. Breakdown of Oppenheimer approximation; vibrations of polyatomic molecules. far IR region, metal-ligand vibrations, normal co-ordinate analysis. Simple applications.	15 Lectures

Department of Chemistry

Govt P G College Berinag

Teaching Plan

Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

5	**Raman Spectroscopy:** Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual principles. Resonance Raman spectroscopy, Coherent anti-stokes Raman Spectroscopy (CARS), Simple applications.	8 Lectures

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Dr. Balam Singh Bisht, Assistant Professor (Organic Chemistry)

M.Sc. SEMESTER III Paper IV

Inter disciplinary topics in chemistry

S.No.	Contents	Contact Hours/ Lectures
1	**Green Chemistry:** Basic principles of green chemistry. Designing green reagents: green catalyst phase transfer catalysis for green synthesis choice of starting materials, organic synthesis in solid phase reagents, versatile ionic liquids as Scherrer methode.	10 Lectures
2	**Nano chemistry**: History, definition and scope of nanomaterials,	10
	chemical methods for synthesis of nanomaterials, methods of characterization, determination of particle size and surface structure by Scanning Electron microscopy, Transmission Electron microscopy, surface area analysis and Debye-Schrrer method	Lectures
3	**Data Analysis and Computer:** Types of errors, propagation of errors, accuracy and precision, least square analysis, average standard deviation. liner regression, co-variance and correlation coefficient. History of development of computers, Main frames, Mini, Micro and Super Computer systems. General awareness of computer hardware i.e CPU and other peripheral devices Basic structure and functioning of computers with a PC as an illustrative example. Memory, I/Q devices, secondary storage. Computer languages. Operating system with DOS as an example. Introduction to WINDOWS. Data processing, principles of programming. Algorithms and flowcharts.	10 Lectures
4	**Environmental Chemistry:** Concept and scope, composition of atmosphere, terminology and nomenclature, aerosols, photo chemical smog, BOD and COD.	09 Lectures
5	**Medicinal Chemistry:** Primary knowledge of structure activity relationship, SAR, quantitative structure activity relationship (QSAR), Chemistry of antineoplastic agents and cardiovascular drugs	09 Lectures

DEPARTMENT OF CHEMISTRY

GOVT.P.G.COLLEGE BERINAG(PITHORAGARH)

TEACHING PLAN:-2023-24

Mr.BHUPENDRA SINGH BISHT

CLASS-M.Sc.3rd Sem.

SUB- PHOTOCHEMISTRY

S.NO	DATE	UNIT	TOPIC
1	30-10-203	BASIC OF POHTOCHEMISTRY	INTRODUCTION , ABSORPTION AND EMISSION OF PHOTOELECTRON
2	31-10- 2023	"	PHOTOCHEMICAL LAWS , JABLOSKI DIAGRAM AND ITS EXPLANATION
3	20-11-2023	"	PHOTOCHEMICAL STAGES ; PRIMARY AND SECONDARY PROCESS PHOTOPHYSICAL REACTION
4	21-11-2023	"	PHOTOSONSITIZATION ,QUANTAM YIELD AND ITS DETERMINATION
5	22-11-2023	"	FLASH PHOTOLYSIS ,STOPPED FLOW TECHNIQUES
6	27-11-2023	"	REACTIONS OF HIGH AND LOW QUANTUM YEILDES ,SOME REACTION ,FLUROSENCE
7	28-11-2023	"	PHOSPHORESCENCE , CHEMILUMISCENCE WITH EXAMPLES
8	29-11-2023	PHOTOCHEMISTRY OF ORGANIC COMPOUND	INTRODUCTION , PHOTOCHEM OF ALKENES CIS-TRANS ISOMERISM OF ALKENES
9	12-4-2023	"	NON VERTICAL ENERGY TRANSFER ,PHOTOCHEMICAL ADDITION , REACTION OF 13 AND 1,4 DENES DIMENSION
10	12-5-2023	PHOTOCHEMISTRY OF ORGANIC COMPOUND	INTRODUCTION CTION,NORRISN TYPE -I,II EXPLANTION REOCTIONS IN CYCLIC $ ACEJCLIC COMP'S
11	12-6-2023	"	NORRISH TYPE I $II REACTION IN X ,B AND B,Y ANSATUWATED KETIONES
12	12-11-2023	"	PATESRON - BUCHI REACTION AND ITS EXPLENOTION , DHOTOREDUCTION RXNS IN CORBONYE COMPRUNDS .
13	12-12 2023	PHOTOCHEMISTRY OF AROMATIC COMPOUND.	INTRODUTION , ISORREISISATION RXNS IN ,CARBONYL COMPOUNDS .
14	13-12-2023	"	DEWAR AND PRISMIANE BENZENE ISORREISATIONS.
15	18-12 2023	"	SINGLET OXYGEN RXNS, PHOTO FRIES REOSSOMGEMENT OF ETHERS.
16	19-12-2023	"	PHOTO FRIES REASSANGMENT OF ANILINDAS BASTON RXN WITH SOME EXAMEPLES.
17	26-12-2023	"	SOME PRACTIC OF BASTON REOCTION .
18	27-12-2023	"	HOFFRRANN -LOEFLER -FREYTAY REOCTION AND SOME OTHER IRRP REACTION.

DEPARTMENT OF CHEMISTRY
GOVERNMENT PG COLLEGE BERINAG
TEACHING PLAN 2023-24
MR BHUPENDRA SINGH BISHT
CLASS -B.Sc.Ist sem.

SUB- INORGANIC & PHYSICAL CHEMISTRY

S.N0	DATE	UNIT	TOPIC	
1	8-9-2023	ATOMIC STRUCTURE AND PERIODIC PROPERTIES	INTRODUCTION,DUAL NATURE OF MATTER,DE-BROGLIE CONCEPT,HISENBERG NCERTANITY PRINCIPAL	BERG U ERTAINAITY PRINCIPAL
2	9-9-2023	"	SIGNIFICANCE OF HISENBERG UNCERTANITY PRINCIPAL	
3	14-9-2023	"	ATOMIC ORBITALS,SCHRODINGER WAVE EQUATION,SIGNICANCE OF ¥AND ¥**2**	
4	15-09-2023	"	QUANTUM NUMBER,SHAPES OF S,P,D ORBITALS	
5	16-9-2023	"	AUFBAU ENERGY DIAGRAM,PAULI EXCLUSION PRINCIPAL	
6	21-9-2023	"	HUND'S RULE OF MAXIMUM MUTIPLICITY AND ITS EQUATION	
7	22-09-2023	"	ELECTRONIC CONFIGRUATION OF ELEMENT,EFFECTIVE NUCLEAER CHARGE	
8	23-9-2023	"	SLATER'S RULES AND ITS APPLICATION	
9	23-9-2023	"	GENERAL IDEA OF MODERN PERIODIC TABLE , ATOMIC AND IONIC RADII	
10	30-9-2023	"	IONISATION POTENTIAL,ELECTRONIC AFFINITY AND ITS TRENDS IN PERIODIC TABLE	
11	10-5-2023	"	ELECTRONEGATIVITY AND ITS APPLICATIOJN	
12	6-6-2023	CHEMICAL BONDING	TYPES OF CHEMICAL BONDS,VBT AND ITS LIMITATIONS	
13	7-7-2023	"	VARIOUS TYPES OF HYBRIDISATION	
14	10-12-2023	"	VSPER THEOREY AND SHAPES OF VARIOUS MOLECULES INCLUDED IN SYALLABUS	
15	13-10-2023	"	RESONANCE ,HYPRCONJUGATION AND SOME EXAMPLES	
16	14-10-2023	"	INDUCTIVE,MESOMERIC AND ELECTROMERIC EFFECTWITH EXAMPLE	
17	19-10-2023	STATES OF MATTER	INTODUCTION OF CRYSTALLINE MATERIALS,DEFINITION OF SPACE LATTICE ,UNIT CELL	
18	20-10-2023	"	MILER INDICES,LAWS OF CRYTALLEOGRAPHY	
19	21-10-2023	"	SYMMETRY ELEMENTS IN CRYSTALLINE X-RAYS DIFFRATION OF CRYSTALS	
20	22-11-2023	"	BRAGG'S EQUATION AND NUMERICAL PROBLEMS	
21	16-11-2023	"	COLLOIDAL STATE OF DEFINATION CLASSIFICATION OF COLLIDES	
22	19-2-2023	"	EXPLANATION OF SOLS AND PROPERTIES KINECTIC,OPTICAL AND ELECTRICAL	
23	19-2-2024	"	STABILITY OF COLLIODS,PROTECTIVE ACTION	
24	23-11-2024	"	HARDY SCHULZE LAW, GOLD NUMBER	
	DEPARTMENT OF CHEMISTRY			
	TEACHING PLAN 2023-24			
	CLASS BSC 3 SEMESTER			
	SUBJECT-INORGANIC +PHYSICAL CHEMISTRY			

SN.O	DATE	UNIT	TOPIC
1	21-11-2023	CHEMISTRY OF TRANISITION ELEMENTS I,II ,III, SERIES	INTODUCTION ,CHARACTERSTICS OF D-BLOCK ELEMENTS
2	22-11-2023	"	ELECTRONIC AND IONIC RADII,OXIDATION STATES
3	27-11-2023	"	IONISATION ENERGY BOILING AND MELTING POINTS
4	28-11-2023	"	COMPLEX FORMATION, COLOUR AND CATALYTIC PRPERTIES
5	29-11-2023	"	MAGNETIC PRPERTIES CO-ORDINATION NUMBER AND GEOMETRY
6	12-4-2023	"	COMPRATIVE TREATMENT OF 3D,4D,SERIES,MAGNETIC BEHAVIOUR
7	12-5-2023	"	COMPLEX FORMATION OF 4D TO 5D SERIES , MAGNETIC BEHAVIOUR
8	12-6-2023	"	GEOMETRY AND COLOUR OF 4DTO 5D SERIES
9	12-11-2023	CO-ORDINATION CHEMISTRY-I	INTRODUCTION ,DEGINITION CO-ORDINATION NUMBER ,CO-ORDINITIONSPHERE
10	12-12-2023	"	COMPLEX IM OTO TRANISTION METAL COMPLEX ,
11	13-12-2023	"	IUPAC NOMENCLATUSE OF CO-ORDINATION COMPOUNDS.
12	18-12-2023	"	WERNES'S THEORY OF CO-ORDINATION COMPOWDS

13	19-12-2023	"	EAN AND 18-ELECTION RALE
14	20-12-2023	"	STABILITY OFCOMPLEXEL AND FACTOR AFFECTIRIG STABILITY OF COMPLEXES
15	2-5-2024	"	CHILATE ,FACTOR AFFRCTING THE STABILITY OF COMPLEXE(CHDATA)
16	2-6-2024	"	THERNODYNAMIC STABILITY,APPLICATION '
17	2-7-2024	"	VBT AND GEOMETRY OF COMPLEXES
18	2-12-2024	"	MAGNETIC PROPERTIE OF COMPLEX COMPOUNDS AND ITS QUESTIONS
19	13-2-2024	CHEMICAL EQUILIBRIUM -I	INTRODUCTION ,THE LOW OF MASS ACTION ,FREE ENERGY .
20	14-2-2024		EQUILIBSIUM CONSTANT , FACTOR AFFECTING EQUILIBSIUN CONSTANT
21	14-2-2024		RELATIONSHIP BLW K P AND K C LE-CHATELIES 'S PRINCIPLE
22	19-2-2024		NUMERICALS OF ABOVE TOPICS
23	19-2-2024		PHASE EQUILIBRIUM , MEANING OF PHASE , COMPONENT AND DEGREE OF FREEDOM
24	20-2-2024		GIBBS PHASE RULE,PHASE EQUILIBRIA OF ONE COMPONENT SYSTEM ,
25	20-2-2024		PHASE EQUIBRIUM OF H2O,CO2,& SULPHUR,
26	21-2-2024		RAULT'SAND HENRY LAW AND ITS QUESTIONS.

DEPARTMENT OF CHEMISTRY

GOVT. P.G. COLLEGE BERINAG (PITHORAGARH)

TEACHING PLAN (2023-24)

Mr. BHUPENDRA SINGH BISHT

CLASS-M.SC. I SEM

SUBJECT- INORGANIC CHEMISTRY + PHYSICAL CHEMISTRY

S.NO.	DATE	UNIT	TOPIC
1	23-11-2023	a- Stercochemistry and bonding in main group comp	Introduction, VSEPR Theory and its significance, structures included in syllabus
2	24-11-2023	"	dp-pp bonds, Bent's rule for TBP geometry Energetics of hybridisation
3	25-11-2023	"	Metal borides, carbides & ritrides preparation , properties, structure & applications
4	30-11-2023	M-L equilibria in solution	Concept of thermodynamic and kinetic stabilities , step wise and overall formation constants and their relation
5	01-12-2023	"	Factors affecting stability of complexes chelate effect and its therodynamic origin
6	01-12-2023	"	Determination of binary constants by PH- metry and spectrophotometry
7	07-12-2023	Metal p-acid complexes	Introduction, Metal carbonyls, structure and bonding, vib spectra of m-co bonding
8	08-12-2023	"	Reactions of metal carbonyls,metal nitrosyl : preparation, bonding & structure.
9	09-12-2023	"	Important reactions of transition metal nitrosyls,Complexes of dinitrogen,dioxygen and tertiary phosphine.
10	14-12-2023	cluster compounds	Introduction,higher boranes,carboranes,mettaloboranes.
11	15-12-2023		Mettalocarboranes,metal carbonyl and metalhalide clusters.
12	16-12-2023		clusters with M-M multiple bonds and some questions.
13	21-12-2023	Polyoxometalates	Introduction,Isopoly and heteropoly acids and salts of V, Mo,W.
14	22-12-2023		Nomenclature, classification, preparation and structural aspects of polyacids and anions.
15	23-12-2023	Chemical dynamics	Introduction,Third and general order reactions.
16	28-12-2023		Experimental methods for kinetic studies:-Conductometric, potentiometric and Spectrophotometric methods.
17	29-12-2023		Effect of temperature on rate of reaction.Derivation of Arrhenius equation.
18	30/12/2023		Collision theory of reaction rates,steric factor,activated complex theory
19	2-2-2024	"	Ionic reactions,kinetic salt effects,steady state concept,kinetic and thermodynamic control of reactions.
20	3-2-2024	"	Kinetics of gaseous reactions on solid surface,unimolecular & bimolecular surface reactions.
21	8-2-2024	"	Kinetics of condensation and addition polymerization reactions
22	9-2-2024	"	Mechanism of H2-Br2 ,H2-Cl2 reactions decomposition of acetaldehyde,Ozone and H2O2.