Lesson Plan

Name of the Faculty : **Dr. Vinod Khatri**

Class : **B. Sc- I**

Semester : **First Semester (2023-24)**

Subject : **Organic Chemistry, Physical Chemistry & Chemistry Practical.**

Paper Code : **CHE 101 B, CHE 101 C, CHP 101**

Lectures	Topic (including assignment and test)
July & August 2023	**Organic Chemistry**: Structure and Bonding: Localized and delocalized chemical bond, van der Waals interactions, resonance, hyperconjugation, inductive effect, Electromeric effect. Stereochemistry of Organic Compounds: Concept of isomerism. Types of isomerism. Optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. **Physical Chemistry**: Gaseous States: Maxwell's distribution of velocities and energies, Calculation of root mean square velocity, average velocity and most probable velocity. Collision diameter, collision number, collision frequency and mean free path. Deviation of Real gases from ideal behavior. Derivation of Vander Waal's Equation of State, its application. Explanation of behavior of real gases using Vander Waal's equation.
September 2023	**Organic Chemistry**: Stereochemistry of Organic Compounds: Relative and absolute configuration, sequence rules, R & S systems of nomenclature. Geometric isomerism determination of configuration of geometric isomers. E & Z, Conformational isomerism conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds, Newman projection and Sawhorse formula, Difference between configuration and conformation. **Physical Chemistry**: Critical Phenomenon: Critical temperature, Critical pressure, critical volume and their determination. PV isotherms of real gases, continuity of states, the isotherms of Vander Waal's equation, relationship between critical constants and a & b. Critical compressibility factor. The Law of corresponding states. Liquefaction of gases.
October 2023	**Organic Chemistry**: Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents-electrophiles and nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediates carbocations, carbanions, free radicals, carbenes, arynes and Nitrenes. Assigning formal charges on intermediates and other ionic species. **Chemistry Practical**: To prepare arsenious sulphide sol and compare the precipitating

	power of mono-, bi – and trivalent anions. To determine the surface tension of a given liquid by drop number method.
November & December 2023	**Organic Chemistry**: Alkanes and Cycloalkanes: IUPAC nomenclature of branched and unbranched alkanes , the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation physical properties. Cycloalkanes: nomenclature, synthesis of cycloalkanes and their derivatives – photochemical (2+2) cycloaddition reactions, dehalogenation of -dihalides, pyrolysis of calcium or barium salts of dicarboxylic acids, Baeyer's strain theory and its limitations., theory of strain less rings. **Chemistry Practical**: To determine the viscosity of a given liquid. To determine the specific refractivity of a given liquid **Revision and Test**

Signature

Dr. Vinod Khatri

Lesson Plan

Name of the Faculty : **Dr. Vinod Khatri**
Class : **B.Sc- II**
Semester : **Third Semester (2023-24)**
Paper Code : **CHE 201B, CHE 201C, CHP 201**

Lectures	Topic (including assignment and test)
July & August 2023	**Organic Chemistry**: Phenols: Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction, Kolbe's reaction and Schotten and Baumann reactions. **Thermodynamics-I** Definition of thermodynamic terms: system, surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work. Zeroth Law of thermodynamics, First law of thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law – Joule – Thomson coefficient for ideal gases and real gas: and inversion temperature. **Chemistry Practical**: Systematic identification of the following simple mono and bifunctional organic compounds: Naphthalene, anthracene, benzyl chloride, *p*-dichlorobenzene, *m*-dinitrobenzene, *p*-nitrotoluene, resorcinol, hydroquinone, α-naphthol, β-naphthol, benzophenone, ethyl methyl ketone, benzaldehyde,
September 2023	**Organic Chemistry**: UV spectroscopy: Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones, Woodward- Fieser rules, calculation of $_{max}$ of simple conjugated dienes and , -unsaturated ketones. Applications of UV Spectroscopy. Carboxylic Acids & Acid Derivatives: Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids. Mechanism of decarboxylation. Structure, nomenclature and preparation 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 esterification and hydrolysis

October 2023	**Carboxylic Acids & Acid Derivatives** Nomenclature of Carboxylic acids, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids. Mechanism of decarboxylation. Structure nomenclature and preparation of acid chlorides, esters, amides and acid anhydrides. **Physical Chemistry**: Thermodynamics: Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Temperature dependence of enthalpy, Kirchhoff's equation. Bond energies and applications of bond energies
November & December 2023	Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and hydrolysis (acidic and basic). **Test and Assignments**

Lesson Plan

Name of the Faculty : **Dr. Vinod Khatri**
Class : **B.Sc- III**

Semester : **Fifth Semester (2023-24)**

Paper Code : **CHE 301B, CHE 301C**

Lectures	Topic (including assignment and test)
July & August 2023	**Physical Chemistry:** Quantum Mechanics-I: Black-body radiation, Plank's radiation law, photoelectric effect, heat capacity of solids, Compton effect, wave function and its significance of Postulates of quantum mechanics , quantum mechanical operator, commutation relations, Hamiltonian operator, Hermitian operator, average value of square of Hermitian as a positive quantity, Role of operators in quantum mechanics, To show quantum mechanically that position and momentum cannot be predicated simultaneously, Determination of wave function & energy of a particle in one dimensional box, Pictorial representation and its significance. **Organic Chemistry: NMR Spectroscopy-I** Principle of nuclear magnetic resonance, the PMR spectrum,number of signals, peak areas, equivalent and nonequivalent protons positions of signals and chemical shift,shielding and deshielding of protons, proton counting,splitting of signals and coupling constants, magnetic equivalence of protons.
September 2023	**Physical Chemistry:** Physical Properties and Molecular Structure: Optical activity, polarization – (Clausius–Mossotti equation). Orientation of dipoles in an electric field, dipole moment, included dipole moment, measurement of dipole moment temperature method and refractivity method, dipole moment and structure of molecules, Magnetic permeability, magnetic susceptibility and its determination. Application of magnetic susceptibility, magnetic properties – paramagnetism, diamagnetism and ferromagnetic.
October 2023	**Organic Chemistry: NMR Spectroscopy-II** Discuss ion of PMR spectra of the molecules: ethyl bromide, npropyl bromide, isopropyl bromide, 1,1-dibromoethane, 1,1,2-tribromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde and acetophenone..Simple problems on PMR spectroscopy for structure determination of organic compounds. Carbohydrates I: Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose in to mannose. Formation of glycos ides, ethers and esters. Determination of ring size of glucose and fructose. Open chain and cyclic structure of D(+)-glucose & D(-) fructose. Mechanism ofmutarotation. Structures of ribose and deoxyribose.

November & December 2023	**Carbohydrates-II** An introduc tion to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination. **Organometallic Compounds** Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions. **Revision and Test**

Lesson Plan

Name of the Faculty : **Dr. Vinod Khatri**
Class : **B.Sc- I**
Semester : **2nd Semester (2023-24)**
Paper Code : **CHE 102B, CHE 102C, CHP-102**

	Topic (Including Assignment and Test)
Jan. 2024	**Organic Chemistry Alkenes** Nomenclature of alkenes, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides,. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration–oxidation, oxymercuration reduction, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, **Physical Chemistry** Kinetics-I: Rate of reaction , rate equation, factors influencing the rate o f a reaction concentration , temperature, pressure , solvent, light, catalyst. Order of a reaction, integrated rate express ion for zero order, first order, second and third order reaction. Half-life period of a reaction. Methods of determination of order of reaction ,
Feb. 2024	**Organic Chemistry**: **Dienes and Alkynes:** Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of butadiene, Chemical reactions 1,2 and 1,4 additions (Electrophilic & free radical mechanism), Diels-Alder reaction, Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration oxidation of alkynes. **Chemistry Practical**: To study the process of sublimation of camphor and phthalic acid. Preparation and purification of p-Bromo acetanilide from acetanilide, Dibenzalacetone from acetone and benzaldehyde & Aspirin from salicylic acid.

March 2024	**Alkyl and Aryl Halides** Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms and stereochemistry of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams.Methods of formation and reactions of aryl halides, The addition elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides.
April 2024	**Physical Chemistry**: Kinetics-II: Effect of temperature on the rate of reaction-Arrhenius equation. Theories of reaction rate – Simple collision theory for unimolecular and bimolecular collision. Transition state theory of Bimolecular reactions. **Revision & Semester Exams**

Lesson Plan

Name of the Faculty : **Dr. VINOD KHATRI**
Class & Sem. : **B.Sc- II, 4th Semester**
Session : **2023-24**
Subject : **CHE 202B, CHE 202C, CHP 202**

Lectures	Topic (Including Assignment and Test)
Jan. 2024	**Organic Chemistry**: **IR absorption spectroscopy:** Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. Applications of IR. **Thermodynamics:** Second law of thermodynamics, need for the law, different statements of the law, Carnot's cycles and its efficiency, Carnot's theorm, Thermodynamics scale of temperature. Concept of entropy – entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, entropy as criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. **Chemistry Practical**: Gravimetric Analysis: To verify Beer - Lambert law for KMnO4 /K2 Cr2 O7, determine the concentration of the given KMnO4 /K2Cr2 O7 solution, Preparation of Cuprous chloride. To determine the enthalpy of solution of solid calcium chloride, To study the distribution of iodine between water and CCl4.
Feb. 2024	**Organic Chemistry**: **Amines:** Structure and nomenclature of amines, physical properties. Separation of a 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. electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. **Physical Chemistry**: **Thermodynamics:**Third law of thermodynamics: Nernst heat theorem, statement of concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T. **Chemistry Practical**: Preparation of Prussion blue from iron fillings, tetraammine cupric sulphate, chrome alum, potassium trioxalatochromate(III).
March 2024	**Organic Chemistry**: Diazonium Salts: Mechanism of diazotisation, structure of benzene diazonium chloride, Replacement of diazo group by H, OH, F, Cl, Br, I, NO2 and CN groups, reduction of diazonium salts to hyrazines, coupling reaction and its synthetic application. Nitro Compounds: Preparation of nitro alkanes and nitro arenes and their chemical reactions. Mechanism of electrophilic substitution reactions in nitro arenes and their reductions in acidic, neutral and alkaline medium. conventions, electrochemical series and its applications. **Chemistry Practical**: To determine the CST of phenol – water system, To determine the solubility of benzoic acid at various temperatures and to determine the ΔH of the dissolution process, To determine the enthalpy of neutralization of a WA/WB vs.

	SB/SA and determine the enthalpy of ionization of the WA/WB.
April 2024	**Organic Chemistry**: Aldehydes and Ketones: Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, advantage of oxidation of alcohols with chromium trioxide, PCC, PDC, Physical properties. Comparison of reactivities of aldehydes and ketones. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction. Oxidation of aldehydes, Baeyer–Villiger oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, LiAlH4 and NaBH4 reductions. **Revision and Test**

Lesson Plan

Name of the Faculty : **Dr. VINOD KHATRI**

Class : **B.Sc- III, 6th Semester**

Session : **2023-24**

Subject : **CHE 302B, CHE 302C**

Lectures	Topic (Including Assignment and Test)
Jan. 2024	**Organic Chemistry**: Heterocyclic Compounds: Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.
Feb. 2024	**Organic Chemistry**: Heterocyclic Compounds: Introduction to condensed five and six-membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of, quinoline and isoquinoline, Organosulphur Compounds: Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine. Synthetic detergents alkyl and aryl sulphonates. **Physical Chemistry**: **Electronic Spectrum** Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck- Condon principle. Qualitative description of sigma and pie and n molecular orbital (MO) their energy level and respective transitions.
March 2024	**Organic Chemistry**: Organic Synthesis *via* Enolates: Acidity of -hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. 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, epoxy resins and polyurethanes. Natural and synthetic rubbers. **Physical Chemistry**: **Photochemistry** Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grotthus-Drapper law, Stark- Einstein law (law of photochemical equivalence) Jablonski diagram depiciting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing),quantum yield, photosensitized reactions-energy transfer processes (simple examples).

April 2024	**Organic Chemistry**: Amino Acids, Peptides & Proteins: Classification, of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation of -amino acids. Structure & nomenclature of peptides, proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid–phase peptide synthesis. Structures of peptides and proteins: Primary & Secondary structure. **Revision**