Lesson plan (2020-2021)

Chemistry Department

Odd Semester: Inorganic Chemistry

B.SC –I Sem-1 **INORGANIC CHEMISTRY**

Week-2 Oct.	**Basic Introduction and previous knowledge testing +** Atomic Structure- Idea of de Broglie matter waves
Week -3 Oct.	Heisenberg uncertainty principle, atomic orbitals, quantum numbers.
Week -4 Oct.	Radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals
Week -1 Nov.	Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements
Week -2 Nov.	**DIWALI BREAK**
Week -3 Nov.	**ASSIGNMENT-1** PROBLEMS
Week -4 Nov.	Effective nuclear charge, Slater's rules.
Week-1 Dec.	Periodic Properties Atomic and ionic radii, ionization energy, electron affinity
Week-2 Dec.	Electronegativity –definition methods of determination or evaluation, trends in periodic table (in s &p block elements).

Week-3 Dec.	**ASSIGNMENT-2 + Covalent Bond** Valence bond theory and its limitations, directional characteristics of covalent bond.
Week-4 Dec.	Various types of hybridization and shapes of simple inorganic molecules and ions (BeF_2 , BF_3 , CH_4 , PF_5 , SF_6, IF_7,SO_4^{2-}, ClO_4^-)
Week-1 Jan.	Valence shell electron pair repulsion (VSEPR) theory to NH_3 , H_3O^+ , SF_4 , CIF_3 , ICI_2^- and H_2O
Week-2 Jan.	**SESSIONAL**
Week-3 Jan.	MO theory of hetero nuclear (CO and NO) diatomic. Molecules Bond strength and bond energy percentage ionic character from dipole moment and electronegativity difference
Week-4 Jan.	Ionic Solids Ionic structures (NaCl, CsCl, ZnS (Zinc Blende), CaF 2) radius ratio effect and coordination number, limitation of radius ratio rule
Week-1 Feb.	Lattice defects, semiconductors, lattice energy (mathematical derivation excluded) and Born-Haber cycle
Week-2 Feb.	Solvation energy and its relation with solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule.
Week-3 Feb.	**Revision**
Week-4 Feb.	**EXAMINATION**

B.Sc.II Sem-3 Inorganic Chemistry lesson plan

October Week-1	Basic Indroduction of d-block elements
Week-2	**Chemistry of d-Block elements** Definition of transition elements, position in the periodic table, General characteristic properties of d-Block elements
Week-3	Comparison of properties of 3d elements with 4d and 5d elements with reference only to ionic radii, oxidation state
Week-4	Magnetic and spectral properties and stereo chemistry. Stability of various oxidation states and e.m.f (Latimer and Frost diagrams)
November Week-1	Structure and properties of some compounds of transition elements- TiO_2, $VOCl_2$, $FeCl_3$, $CuCl_2$ and $Ni(CO)_4$ and **Assignment 1**
Week-2	**DIWALI BREAK**
Week-3	**Coordination Compounds** Werner's theory of coordination compounds, effective atomic number, chelates
Week-4	Nomenclature of coordination compounds, Isomerism in coordination compounds and **Test**

December Week-1	Valence bond theory of transition metal complexes and **problem discussion**.
Week-2	Non-aqueous solvents Physical properties of solvents **and assignment-2**
Week-3	Types of solvents **and Test**
Week-4	General characteristics of solvent.
January Week-1	Sessional
Week-2	Reactions in non aqueous solvents with reference to liquid NH3.
Week-3	Reactions of liquid NH3.
Week-4	Test
February Week-1	Reactions in non aqueous solvents with reference to liquid SO2

Week-2	Reactions of liquid SO2
Week -3	**Revision**
Week-4	**Examination.**

B.Sc III Sem-5 Inorganic Chemistry lesson plan

October Week-1	Basic Indroduction of Transition Metal complexes
Week-2	**Metal- Ligand Bonding in Transition Metal complexes** Limitations of valence bond theory, an elementary idea of crystal field theory,
Week-3	crystal field splitting in octahedral, tetrahedral and square planer complexes, factors affecting the crystal field parameters
Week-4	**Thermodynamics and Kinetic Aspects of metal complexes** -A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, Irving William Series,
November Week-1	Assignment 1+ substitution reactions of square planer complexes of Pt[II], Trans effect.
Week-2	**DIWALI BREAK**
Week-3	Discussion+ Magnetic properties of Transition metal complexes Types of magnetic materials, magnetic susceptibility, method of determining magnetic

	susceptibility
Week-4	spin only formula, L-S coupling,
December Week-1	correlation of μs and μeff values, orbital contribution to magnetic moments
Week-2	Assignment 2+ application of magnetic moment data for 3d metal complexes.
Week-3	Test+Numericals
Week-4	**Electronic spectra of Transition metal complexes**- Selection rules for d-d transition, spectroscopic ground states
January Week-1	Sessional
Week-2	spectrochemical series, orgel energy level diagram for d1 and d9 states
Week-3	Discussion+, **Continue** spectrochemical series, orgel energy level diagram for d1 and d9 states
Week-4	Revision of orgel energy digrams
February Week-1	Test
Week-2	discussion of electronic spectrum of [Ti(H2O)6]+3 complex ion.
Week-3	Revision
Week-4	Examination

Physical Chemistry

Bsc- I Sem-1 Physical

Week-1 Oct	Introduction to States of Matter

Week-2 Oct	**Gaseous States** Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity
Week-3 Oct	Average velocity and most probable velocity. Collision diameter, collision number, collision frequency and mean free path.
Week-4 Oct	Deviation of Real gases from ideal behaviour. Derivation of Vander Waal's Equation of State
Week-1 Nov	Assignment-1,Its application in the calculation of Boyle's temperature (Compression factor).
Week-2 Nov	**DIWALI BREAK**
Week-3 Nov	Explanation of behaviour of real gases using Vander Waal's equation. Numerical practice.
Week-4 Nov	**Critical Phenomenon:** Critical temperature, Critical pressure, Critical volume and their determination.
Week-1 Dec	PV isotherms of real gases, continuity of states, the isotherms of Vander Waal'sequation.
Week-2 Dec	Assignment-2, relationship between critical constants and Vander Waal"s constants
Week-3 Dec	Critical compressibility factor. The Law of corresponding states. Liquefaction of gases. Numericals.
Week-4 Jan	**Liquid States** Structure of liquids. Properties of liquids – surface tension, Viscosity vapour pressure

Week-1 Jan	EXAMINATION
Week-2 Jan	Optical rotations and their determination. Numericals.
Week-3 Jan	**Solid State** Classification of solids, Laws of crystallography – (i) Law of constancy of interfacial angles
Week-4	(ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements of crystals.
Week-1 Feb	Definition of unit cell & space lattice. Bravais lattices, crystal system X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl
Week-2 Feb	Liquid crystals: Difference between solids, liquids and liquid crystals,types of liquid crystals. Applications of liquid crystals.
Week-3 Feb	**Revision**
Week-4 Feb	**Examination.**

B.Sc II Sem-3 CHEMISTRY LESSON PLAN PHYSICAL CHEMISTRY

october Week-1	BASIC INDRODUCTION OF Thermodynamics
Week-2	**Thermodynamics**-Definition of thermodynamic terms: system, surrounding etc. Types of systems, intensive and extensive properties

Week-3	State and path functions and their differentials.
Week-4	Thermodynamic process. Thermodynamic equilibrium, Concept of heat and work.
November Week-1	Assignment 1+ First law of thermodynamics: statement, concepts of internal energy and enthalpy
Week-2	**DIWALI BREAK**
Week-3	**Numericals+** Heat capacity, heat capacities at constant volume and pressure and their relationship
Week-4	Joule–Thomson coefficient for ideal gas and real gas and inversion temperature+ Test
December Week-1	Calculation of w,q, dU & dH for the expansion of ideal gases under isothermal + Numerical
Week-2	Calculation of w,q, dU & dH for the expansion of ideal gases under isothermal adiabatic conditions for reversible process. **+ Assignment 2**
Week-3	Chemical Equilibrium Equilibrium constant and free energy, concept of chemical potential, Thermodynamic derivation of law of chemical equilibrium
Week-4	Temperature dependence of equilibrium constant + Numerical
January Week-1	Sessional
Week-2	Clausius–Clapeyron equation and its applications + discussion
Week-3	Distributioln Law Nernst distribution law – its thermodynamic derivation, Applications of distribution law: (i) Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride

Week-4	(ii) Determination of equilibrium constant of potassium tri-iodide complex
February Week-1	Numerical
Week- 2	(iii) Process of extraction. More stress on numerical problems
Week-3	**Revision**
Week-4	**Examination**

B.Sc III Sem-5 Physical Chemistry lesson plan

October Week-1	Basic Indroduction of Quantum Mechanics
Week-2	**Quantum Mechanics-1** Black-body radiation, Plank's radiation law, photoelectric effect, postulates of quantum mechanics, quantum mechanical operators, commutation relations
Week-3	Hamiltonian operator, Hermitian operator, average value of square of Hermitian as a positive quantity, Role of operators in quantum mechanics
Week-4	To show quantum mechanically that position and momentum cannot be predicated simultaneously, Determination of wave function & energy of a particle in one dimensional box.
November Week-1	**Assignment 1+ Physical Properties and Molecular Structure** Optical activity, polarization (Clausius – Mossotti equation- derivation excluded). Orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method

Week-2	**Diwali Break**
Week-3	**Numerical**+ refractivity method, dipole moment and structure of molecules, Magnetic permeability, magnetic susceptibility and its determination
Week-4	**Test**+ Application of magnetic susceptibility, magnetic properties – paramagnetism, diamagnetism and ferromagnetism.
December Week-1	**Spectroscopy Introduction:** Electromagnetic radiation, regions of spectrum, basic features of spectroscopy, statement of Born-oppenheimer approximation, Degrees of freedom.
Week-2	**Assignment 2**+ Rotational Spectrum : Selection rules, Energy levels of rigid rotator (semi-classical principles),
Week-3	Discussion+ rotational spectra of diatomic molecules , spectral intensity distribution using population distribution (Maxwell-Boltzmann distribution)
Week-4	determination of bond length and isotopic effect . **Vibrational spectrum**:, Energy levels of simple harmonic oscillator
January Week-1	Sessional+ Selection rules of simple harmonic oscillator
Week-2	Numericals+ pure vibrational spectrum of diatomic molecules,
Week-3	determination of force constant and qualitative relation of force constant and bond energy,
Week-4	idea of vibrational frequencies of different functional groups**. Raman Spectrum**- Concept of polarizibility,
February Week-1	pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules
Week-2	Quantum theory of Raman spectra+ **Numerical problems** of all spectroscopy.

Week-3	**Revision**
Week-4	**Examination**

Organic Chemistry

B.SC I Sem-1 ORGANIC CHEMISTRY

WEEK-2 Oct	Introduction of some basic concepts of Organic
WEEK-3 Oct	**Structure and Bonding** Localized and delocalized chemical bond, Vander Waals interactions, resonance: conditions, resonance effect and its applications
WEEK-4 Oct	Hyperconjugation, inductive effect, Electromeric effect & their comparison.
Week-1 Nov	**Stereochemistry of Organic Compounds** Concept of isomerism. Types of isomerism. Optical isomerism — elements of symmetry, molecular chirality
Week-2 Nov	**Diwali Break**
Week-3 Nov	**Assignment-1** + stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccentres.
Week-4 Nov	Diastereomers, threo and erythro diastereomers, meso Compounds resolution of enantiomers, inversion, retention and racemization.
Week-1 Dec	Relative and absolute configuration, sequence rules, R & S systems of nomenclature. Geometric isomerism — determination of configuration of geometric isomers

Week-2 Dec	E & Z system of nomenclature, Conformational isomerism — conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds,
Week-3 Dec	**Assignment-2 +** Newman projection and Sawhorse formulae, Difference between configuration and conformation.
Week-3 Dec	**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 reagent electrophiles and nucleophiles.
Week-4 Dec	Types of organic reactions. Energy considerations. Reactive intermediates — carbocations, carbanions, free radicals carbenes, (formation, structure & stability).
Week-1 Jan	**Alkanes and Cycloalkanes** IUPAC nomenclature of branched and unbranched alkanes, the alkyl group + TEST
Week-2 Jan	**Sessional**
Week-3 Jan	Classification of carbon atoms in alkanes. Isomerism in alkanes, sources. Methods of formation (with special reference to Wurtz reaction, Kolbe reaction
Week-4 Jan	Corey-House reaction and decarboxylation of carboxylic acids), physical properties. Mechanism of free radical halogenation of alkanes: reactivity and selectivity.
Week-1 Feb	Cycloalkanes — nomenclature, synthesis of cycloalkanes and their derivatives
Week-2 Feb	photochemical (2+2) cycloaddition reactions, dehalogenation of α,ω-dihalides, pyrolysis of calcium or barium salts of dicarboxylic acids, Baeyer's strain theory and its limitations., theory of strainless rings.

Week-3 Feb	**Revision**
Week-4 Feb	**Examination.**

B.Sc II Sem-3 Organic Chemistry

Week-2 Oct	Basic Introduction of alcohols, **Alcohols** - Monohydric alcohols :nomenclature
Week-3 Oct	**Alcohols** - Monohydric alcohols :nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters
Week-4 Oct	Hydrogen bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols — nomenclature, methods of formation, chemical reactions of vicinal glycols
Week-1 Nov	Oxidative cleavage [Pb(OAc)4 and HIO4] and pinacol-pinacolone rearrangement
Week-2 Nov	**Diwali Break**
Week-3 Nov	Assignment 1+, **Phenols-** Nomenclature, structure and bonding. Preparation of phenols
Week-4 Nov	Physical properties and acidic character. Comparative acidic strengths of alcohols and phenols
Week-1 Dec.	**Test+** resonance stabilization of phenoxide ion. Reactions of phenols — electrophilic aromatic substitution
Week-2 Dec.	Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction Kolbe's reaction and Schotten and Baumann reactions.

Week-3 Dec.	Assignment2 + **Epoxide-** Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening
Week-4 Dec.	Reactions of Grignard and organo lithium reagents with epoxides.+ **Ultraviolet (UV) absorption spectroscopy** Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra
Week-1 Jan	**Discussion+** types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts.
Week-2 Jan	**SESSIONAL**
Week-3 Jan	UV spectra of conjugated enes and enones, Woodward-Fieser rules, calculation of max of simple conjugated dienes and-unsaturated ketones.b Applications of UV Spectroscopy in structure elucidation of simple organic compounds.
Week-4 Jan	**Carboxylic Acids & Acid Derivatives** structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength.
Week-1 Feb	Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids. Mechanism of decarboxylation. Relative stability of acyl derivatives
Week-2 Feb	Physical properties, inter conversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and hydrolysis (acidic and basic).
Week-3 Feb	**Revision**
Week-4 Feb	**Examinations**

B.Sc. III Sem-5 Organic Chemistry

Week-2 Oct	Basic Introduction of NMR Spectroscopy
Week-3 Oct	**NMR Spectroscopy** Principle of nuclear magnetic resonance, the PMR spectrum, number of signals, peak areas.
Week-4 Oct	Equivalent and non-equivalent protons. Positions of signals and chemical shift, shielding and deshielding of protons.
Week-1 Nov	Proton counting, splitting of signals and coupling constant. Magnetic equivalence of protons. Discussion of PMR spectra of the molecules: ethyl bromide.
Week-2 Nov	**Diwali Break**
Week-3 Nov	Assignment-1 + n-propyl bromide, isopropyl bromide 1,1-dibromoethane.
Week-4 Nov	1,1,2-tribromoethane, ethanol, acetaldehyde, ethyl acetate Toluene, benzaldehyde and acetophenone.
Week-1 Dec	Simple problems on PMR spectroscopy for structure determination of organic compounds.+ TEST
Week-2 Dec.	**Carbohydrates** Classification and nomenclature. Monosaccharides, mechanism of osazone formation.
Week-3 Dec.	Assignment-2 + Inter conversion of glucose and fructose, chain lengthening and chain shortening of aldoses.

Week-4 Dec.	Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides
Week-1 Jan.	Ethers and esters. Determination of ring size of glucose and fructose. Open chain and cyclic structure of D (+)-glucose & D (-) fructose.
Week-2 Jan.	**Sessional**
Week-3 Jan.	Mechanism of mutarotation.Structures of ribose and deoxyribose.An introduction to disaccharides maltose.
Week-4 Jan.	sucrose and lactose polysaccharides (starch and cellulose) without involving structure determination + Test
Week-1 Feb.	**Organometallic Compounds** Organomagnesium compounds: the Grignard reagents-formation, structure and chemical reactions.
Week-2 Feb.	Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.
Week-3 Feb	**Revision**
Week-4 Feb	**Examination**