**Deepak Kumar (Assistant Professor)**

**Lesson plan of Physical Chemistry**

**B.Sc – Non-Medical, 2nd semester, (2023-2024)**

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| Weeks | Topic to be covered |
| 1 | Hydrogen Bonding Definition, Types, E ffects of Hydrogen Bonding on Properties of Substances, A pplicatio n Brief discussion of various  types of Vander Waals Forces |
| 2 | Metallic Bond- Brief Introduction to M etallic Bond, Band Theo ry of  Metallic Bond Semiconductors- Introduction, Types and Applications. |
| 3 | Comparative Study of the Element s Including, Diagonal Relationships, Salient F eatures of Hydrides (Methods of Preparation Excluded),  Solvation a nd C o mp le xa t io n Tende nc ies Including T he i r funct ion in Biosystems. |
| 4 | Chemical Properties of the Noblegases with Emphasis on the ir Low  Chemical Reactivit y |
| 5 | Chemistry of Xenon, Structure and Bonding of Fluorides, Oxides & Oxyfluor ides of Xenon |
| 6 | Emphasis on Comparative Study of Properties of P- Block Elements ( Including Diagonal Relationship and Excluding Methods of  Preparation) |
| 7 | Diborane – Properties and Structure ( as an example of Electron –  Deficient Compound and Multicentre Bonding), Borazene |
| 8 | Chemical Properties and Structure Trihalides of Boron – Trends in Fewis Acid Cha racter Structure of Aluminium ( III) chloride. |
| 9 | Catenation, pπ– dπ Bonding (an Idea), Carbides, Fluorocarbons, Silicates ( Structural Aspects), Silicons – General Met hods of  Preparations, Properties and Uses. |
| 10 | Oxides – Structures of Oxides of N,P. Oxyacids – S tructure and Relative Acid Strengths of Oxyacids of Nitrogen and Phosphorus.  Structure of White, Ye llow and Red Phosphorus. |
| 11 | Oxyacids of Sulphur – Structures and Acidic Strength H2 O 2 – Structure, Properties and Uses. |
| 12 | Basic Propert ies of Halogen, Interhalogens Types Propert ies, Hydro  and Oxyacids of Chlor ine – S t ructure and Compar iso n of Acid S t re ngth |

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| **WEEKS** | **CHAPTER** |
| 1. | **Alkenes :-**Nomenclature of alkenes, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides,. |
| 2. | The Saytzeff rule, Hofmann elimination, physical properties and relative  stabilities of alkenes |
| 3. | Chemical reactions of alkenes, mechanisms involved in hydrogenation,  electrophilic and free radical additions, |
| 4. | Markownikoff’s rule, hydroboration–oxidation, oxymercurationreduction |
| 5. | ozonolysis, hydration, hydroxylation and oxidation with KMnO4, |
| 6. | **Arenes and Aromaticity:-** Nomenclature of benzene derivatives:.  Aromatic nucleus and side chain. |
| 7. | Aromaticity: the Huckel rule, aromatic ions, annulenes up to 10 carbon  atoms,aromatic, anti - aromatic and non – aromatic compounds |
| 8. | Aromatic electrophilicsubstitution general pattern of the mechanism, mechansim of nitration,halogenation, sulphonation, and Friedel-Crafts  reaction. |
| 9. | Energy profile diagrams, Activating , deactivating subs tituents and  orientation. |
| 10. | **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), |
| 11. | 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, hydroborationoxidationof alkynes |
| 12. | **Alkyl and Aryl Halides:-**Nomenclature and classes of alkyl halides,  methods of formation, chemical reactions. |
| 13. | Mechanisms and stereochemistry of nucleophilic substitution reactions of  alkyl halides , SN2 and SN1reactions with energy profile diagrams. |
| 14. | Methods of formation and reactions of aryl halides, |
| 15. | The additionelimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of  alkyl halides vsallyl, vinyl and aryl halides. |

**Dr. Vikash (Assistant Professor) Lesson plan of Organic Chemistry**

B.Sc–Non-Medical, 2nd semester, 2023-2024

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| 1. | Kinetics-I:-Rate of reaction, rate equation, factors influencing the rate of a reaction –concentration, temperature, pressure, solvent, light, catalyst. |
| 2. | Order of a reaction, integrated rate expression for zero order, first order, second and third order reaction |
| 3. | Half life period of a reaction. Methods of determination of order of reaction.  Kinetics-II Effect of temperature on the rate of reaction – Arrhenius equation. |
| 4. | Kinetics-II:- Theories of reaction rate – Simple collision theory for unimolecular and bimolecular collision. Transition state theory of Bimolecular reactions |
| 5. | Electrochemistry-I:- Electrolytic conduction, factors affecting electrolytic conduction, specific, conductance, |
| 6. | molar conductance, equivalent conductance and relation among them, their variation with concentration. Arrhenius theory of ionization |
| 7. | Ostwald’s Dilution Law. Debye- Huckel – Onsager’s equation for strong electrolytes (elementary treatment only) Transport number, definition and and determination by Hittorfs methods, (numerical included) |
| 8. | Electrochemistry-II:-Kohlarausch’s Law, calculation of molar ionic conductance and effect of viscosity temperature & pressure on it. |
| 9. | Application of Kohlarausch’s Law in calculation of conductance of weak electrolytes at infinite diloution. Applications of conductivity measurements: determination of degree of dissociation, determination of Ka of acids determination of solubility product of sparingly soluble salts, |
| 10. | conductometric titrations. Definition of pH and pKa |
| 11. | Buffer solution, Buffer action, Henderson-Hazel equation, |
| 12. | Buffer mechanism of buffer action. |
| 13. | Unit test:  Revision |
| 14. | Revision |
| 15. | Unit Test:02 |

**Dr. Ajay Kumar Assistant Professor of Chemistry**

**Lesson plan of Physical Chemistry**

B.Sc–Non-Medical, 2nd semester, 2023-2024

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| **Deepak Kumar (Assistant Professor)**  **Lesson plan of Organic Chemistry**  **B.Sc – Non-Medical, 4th semester, (2023-2024)** | |
| **WEEKS** | **CHAPTER** |
| 1. | IR SPECTROSCOPY :- Molecular Vibrations, Hook’s law, selection rules Intensit and position of IR bands, measurement of IR spectrum, Finger print  Region Characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds. Application of IR spectroscopy in structure  elucidation of simple organic compounds |
| 3. | Aldehydes and ketones:- Nomenclature and structure of 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(sarett reagent) PCC and pyridine dichromate |
| 4. | Physical properties of aldehydes and ketones, comparison of reactivities of aldehydes and ketones. Mechanism of benzoin condensation , aldol condensation  &perkin condensation, Mechanism of knoevenagel condensation, condensation with ammonia and its derivatives , wittig reaction |
| 6. | Mannich reaction, oxidation of aldehydes, Baeyer villiger oxidation of ketones,  cannizzaro reaction, MPV reaction, clemmenson, wolfkishner, LiAlH4, NaBH4 reduction |
| 8. | Diazonium salt :- Nomenclature, preparation of Diazonium salt, Physical and  chemical Properties, synthetic applications of diazonium salt |
| 9. | Nitrocompounds :- preparations of nitro compounds, physical properties of nitro  compounds, reactions of nitro alkanes and nitroarenes |
| 10. | Amines:- Structure of amines, nomenclature of amines, preparation of amines, , |
| 11. | separation of primary secondary and tertiary amines, chemical properties of  amines, distinction of primary secondary and tertiary amines, |
| 12. | basicity of amines, effect of substituents on the basicity of amines, Revision of Amines, nitro compounds and diazonium salt |

**Dr. Vikash (Assistant Professor) Lesson plan of Physical Chemistry**

B.Sc–Non-Medical, 4th semester, 2023-2024

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| **WEEKS** | **CHAPTER** |
| 1. | ***Thermodynamics-II*:** Second law of thermodynamics, need for the law, different statements of the law, Carnot’s cycles and its efficiency, Carnot’s theorem, |
| 2. | Thermodynamics scale of temperature. Concept of entropy – entropy as a state function, entropy as a function ofV & T, entropy as a function of P & T |
| 3. | entropy change in physical change,entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. |
| 4. | ***Thermodynamics- III:***Third law of thermodynamics: Nernst heat theorem, statement of concept of residual entropy, evaluation of absolute entropy from heat capacity data. |
| 5. | *Thermodynamics- III:*  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 |
| 6. | Variation of G and A with P, V and T.  ***Electrochemistry:***Electrolytic and Galvanic cells – reversible & Irreversible cells , conventional representation of electrochemical cells.. |
| 7. | EMF of cell and its measurement, Weston standard cell, activity and activity coefficients. Calculation of thermodynamic quantities of cell reaction ( G, H & K). |
| 8. | Types of reversible electrodes – metal- metal ion gas electrode, metal –insoluble salt- anion and redox electrodes. Electrode reactions, Nernst equations, derivation of cell EMF and single electrode potential. Standard Hydrogen electrode, reference electrodes, standard electrodes potential, sign conventions, electrochemical series and its applications. |
| 9. | Types of reversible electrodes – metal- metal ion gas electrode, metal –insoluble salt- anion and redox electrodes. Electrode reactions, Nernst equations, derivation of cell EMF and single electrode potential. |
| 10. | Standard Hydrogen electrode, reference electrodes, standard electrodes potential, sign conventions, electrochemical series and its applications. |
| 11. | Concentration cells with and without transference, liquid junction potential, |
| 12. | application of EMF measurement i.e. valency of ions, solubility product activity coefficient |
| 13. | potentiometric titration (acid- base and redox) **UNIT TEST-1** |
| 14. | Determination of pH using - Hydrogen electrode, Quinhydrone electrode and glass electrode by potentiometric Methods. |
| 15. | UNIT TEST -2, Revision |

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| 1. | **Lanthanides**- Introduction, electronic structure and position in the periodic table, oxidation state, magnetic Doubts |
| 2. | Ionic radio and lanthanides contraction and it’s consequences |
| 3. | Complex formation by lanthanides , occurrence , Extraction of lanthanides from monazite sand , |
| 4. | Gibbs (G) and Helmholtz functions (A) as thermodynamic quantities |
| 5. | **Actinides:**-Introduction , electronic structure and position in the periodic table, oxidation states, physical pr |
| 6. | Transuranic elements , separation of Pu,Np,Am,fromU |
| 7. | Comparison of lanthanides and actinides , Possible new elements, Doubts, Assignment, Class test |
| 8. | **Theory of Qualitative and Quantitative Inorganic:**-Introduction, Qualitative analysis, Preliminary tests |
| 9. | Wet test for Acid radicals |
| 10. | Analysis of group 1,2,3,4,5,6 cations |
| 11. | Identification of acid radicals in typical combinations, Interference of acid radicals in the analysis of basic radicals |
| 12. | Solubility product,PHvalue,effect of temperature |
| 13. | Unit test |

**Dr. Ajay Kumar Assistant Professor of Chemistry**

**Lesson plan of Inorganic Chemistry**

B.Sc–Non-Medical, 4th semester, 2023-2024

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| **Deepak Kumar (Assistant Professor)**  **Lesson plan of Physical Chemistry**  **B.Sc – Non-Medical, 6th semester, (2023-2024)** | |
| **WEEKS** | **Topics to be covered** |
| 1. | Solutions: Dilute Solutions and Colligative Properties Ideal and non-ideal solutions. Methods of expressing concentrations of solutions,  Activity and activity coefficient. Dilute solution,Colligative properties,  Raolut’s law |
| 2. | Relative lowering of vapour pressure, molelcular weight determination, Osmosis law of osmotic pressure and its measurement |
| 3. | Determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point Thermodynamic derivation of relation between molecular  weight and elevation in boiling point and depression in freezing point |
| 4. | Experimental methods for determining various colligative properties.Abnormal molar mass, degree of dissociation and association of solutes. |
| 5. | Doubts, Class test , Phase Equillibrium-  Statement and meaning of the terms – phase component and degree of freedom. Thermodynamic derivation of Gibbs phase rule |
| 6. | Phase equilibria of one component system –Example – water and Sulpher systems. Phase equilibria of two component systems solid-liquid equilibria, Simple eutectic  Example Pb-Ag system, desilerisation of lead , |
| 7. | Electronic Spectrum -Concept of potential energy curves for bonding and antibonding molecular orbitals , qualitative description of selection rules Franck Condon principle, Qualitative description of sigma and pie and n molecular orbital (MO) |
| 8. | Photochemistry-  Interaction of radiation with matter, difference between thermal and photochemical processes |
| 9. | Laws of photochemistry: Grotthus-Drapper law, Stark Einstein law (law of photochemical equivalence), Jablonski diagram depiciting -various processes occurring in the excited state, |
| 10. | qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing)  Quantum yield, photosensitized reactions-energy transfer processes (simple examples). |

**Dr. Vikash (Assistant Professor) Lesson plan of Inorganic Chemistry**

B.Sc–Non-Medical, 6th semester, 2023-2024

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| **WEEKS** | **CHAPTER** |
| 1. | Organometallic Chemistry Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding of alkyls of Li, Al, Hg, and Sn a brief account of metal-ethylenic complexes, mononuclear carbonyls and the nature of bonding in metal carbonyls |
| 2. | bonding of alkyls of Li, Al, Hg, and Sn a brief account of metal-ethylenic complexes, |
| 3. | mononuclear carbonyls and the nature of bonding in metal carbonyls |
| 4. | **Acids and Bases, HSAB Concept**  Arrhenius, Bronsted — Lowry, the Lux — Flood |
| 5. | Solvent system and Lewis concepts of acids & bases, relative strength of acids & bases. |
| 6. | **Acids and bases ,HSAB concept**  Concept of Hard and soft acid and bases. Symbiosis, electronegativity and hardness and softness |
| 7. | **Bioinorganic Chemistry**  Essential and trace elements in biological processes |
| 8. | metalloporphyrins with special reference to hemoglobin and myoglobin |
| 9. | Biological role of alkali and alkaline earth metal ions with special reference to Ca2+. Nitrogen fixation. |
| 10. | **Sil icones** Silicones, their preparation, properties, structure and uses |
| 11. | **Phosphazenes**  Phosphazenes, their preparation, properties, structure and uses |
| 12. | Unit test:01  Revision |
| 13. | Unit test :02 |
| 14. | Revision |

**Dr. Ajay Kumar Assistant Professor of Chemistry**

**Lesson plan of Inorganic Chemistry**

B.Sc–Non-Medical, 6th semester, 2023-2024

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| **WEEKS** | **CHAPTER** |
| 1. | **Heterocyclic Compounds-I**  Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. |
| 2. | Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. |
| 3. | Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. |
| 4. | HeterocyclicCompounds-II  Introduction to condensed five and six- membered heterocycles. Prepration and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis |
| 5. | Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of, quinoline and isoquinoline. |
| 6. | OrganosulphurCompounds Nomenclature, structural features, Methods of formation and chemical reactions of thiols, thioethers |
| 7. | sulphonic acids, sulphonamides and sulphaguanidine. Synthetic detergents alkyl and aryl sulphonates. |
| 8. | **Organic Synthesis *via* Enolates**  Acidity of alpha-hydrogens alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethylacetoacetate. |
| 9. | SyntheticPolymers Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. |
| 10. | Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy re sins and polyurethanes.  Natural and synthetic rubbers. |
| 11. | Amino Acids, Peptides& Proteins Classification, of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation of alpha -amino acids. Structure and nomenclature of peptides and proteins. |
| 12. | Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides |
| 13. | Unit test:01  Revision |
| 14. | Revision |