**Government College for Women, Bawani Khera (Bhiwani)**

**Department of Chemistry**

Academic year: 2023-24

**Objectives of Teaching the Paper:**

In this course, the learners will be able to develop expertise related to the following:

1. Understand the basic concept of IR, NMR spectroscopy & Mass Spectrometry.

2. Understand the basics of quantum mechanics & molecular spectroscopy

**Mode of Transaction for the Paper:**

• Discussions

• Lectures and class assignments

• YouTube Lectures and Presentations

**Course Outcomes:**

After completion of this course, the learners will be able to:-

1. Explain the structure elucidation process using various spectroscopic techniques.
2. Solve the problems related to quantum mechanics viz. Particle in one dimensional box, three dimensional box.
3. Explain the difference between various photo-physical processes like fluorescence & phosphorscence

**Suggested Readings:**

1. Spectrometric identification of Organic Compounds, R.M. Silverstein, G.C. Bassler, and T.C. Morrill, John Wiley.
2. Spectroscopy, G.M. Lampman, D.L. Pavia, G.S. Kriz and J.M. Vyvyan, Cengage Learning.
3. Banwell, C.N. & McCash, E.M. Fundamental of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill (2006)
4. Rogers, D.W. Concise Physical Chemistry, Wiley (2010)

**Teaching Plan for the Academic Session 2023-24**

**Teacher: Hemant Kumar Class: B.Sc., Semester: 6th**

| **Week** | **Concept Breakdown** |
| --- | --- |
| **Week 1**  **01.02.2024 to03.02.2024** | Infrared Spectroscopy: Application of IR in structure elucidation of carbonyls |
| **Week 2**  **05.02.2024**  **to**  **10.02.2024** | Effect of H-bonding in unsaturated mono and disubstituted aromatic compounds, metal – ligand vibrations, group frequencies of complex ligands – CN stretching & Effect of coordination on it, nitro & C=O ligand and effect of their coordination with metal ions. Applications of far & near IR |
| **Week 3**  **12.02.2024**  **to**  **17.02.2024** | NMR Spectroscopy: Basic principles of NMR, Chemical shift and its measurement, factors influencing chemical shift, spin spin coupling, mechanism of nuclear spin spin interactions, Different spin systems, coupling constant & factors affecting coupling constants. |
| **Week 4**  **19.02.2024**  **to**  **24.02.2024** | Anisotropic effects in alkene, alkyne, aldehydes aromatics. Simplification of proton spectra with examples. NMR spectroscopy-II: Interpretation of PMR spectra of simple organic compounds. |
| **Week 5**  **26.02.2024**  **to**  **02.03.2024** | Distinction between geometrical isomers on the basis of NMR.  C13 NMR Spectroscopy: Basic principle, chemical shift and its calculation. Applications of IR, UV & NMR for identification of simple organic molecules |
| **Week 6**  **04.03.2024**  **to**  **09.03.2024** | Mass Spectrometry: Introduction, ion production – EI, CI, FD & FAB, factors affecting fragmentation, McLafferty rearrangement, Nitrogen rule. Mass spectral fragmentation of organic compounds having common functional groups. Combined problems relating to structure elucidation by UV, IR, NMR spectroscopy & Mass spectrometry |
| **Week 7**  **11.03.2024**  **to**  **16.03.2024** | Quantum Mechanics-I: Black body radiation, Plank’s radiation law, photoelectric effect, wawe function and its significance, postulates of quantum mechanics, quantum mechanical operator, communication relations. |
| **Week 8**  **18.03.2024**  **to**  **22.03.2024** | Hemiltonian operator, Schrodinger equation & its application to free particle & particle in a box problem, Quantization of energy levels, zero point energy, degeneracy, extension to three dimensional boxes boxes. Heisenberg uncertainty principle. |
| **Week 9**  **01.04.2024**  **to**  **06.04.2024** | Quantum mechanics-II: Rigid rotator model of rotation of diatomic molecule, schrodinger equation, transformation of spherical polar coordinates, separation of variables, spherical harmonics, qualitative discussion of solution. |
| **Week 10**  **08.04.2024**  **to**  **13.04.2024** | Molecular spectroscopy-I: Interaction of EM radiation with molecules & various type of spectra, Born Oppenheimer approximation. Rotational Spectroscopy: Selection rules, Intensities of spectral lines, determination of bond lengths of diatomic and triatomic molecules, isotopic substitution. |
| **Week 11**  **15.04.2024**  **to**  **20.04.2024** | Vibrational spectroscopy: Classical concept of vibration, computation of force conatant, anharmonicity, morse potential curve, dissociation energies, vibrating diatomic rotator, fundamental frequencies, overtones, hot bands, vibration-rotation spectroscopy: P,Q,R branches. |
| **Week 12**  **22.04.2024**  **to**  **27.04.2024** | Molecular Spectroscopy-II: Raman Spectroscopy – Qualitative treatment of Rotational Raman effect, effect of nuclear spin, Vibrational Raman spectra, stokes & anti-stokes lines, their intensity & rule of mutual exclusion. |
| **Week 13**  **29.04.2024**  **to**  **30.04.2024** | Electronic Spectroscopy: Frank-Condon principle, electronic transitions, singlet & triplet states, fluorescence & phosphorescence, dissociation & predissociation, calculation of electronic transitions of polyenes using free electron model. |

**Name: Hemant Kumar Signature**

**Assistant professor**

**Government College for Women, Bawani Khera (Bhiwani)**

**Department of Chemistry**

Academic year: 2023-24

**Objectives of Teaching the Paper:**

1. The students will learn about organic compounds of Nitrogen viz. Amines, Diazonium salts & Nitro compounds.

2. Students will learn about electrochemistry and Electrolytic conductance.

3. Students will learn about amino acids, proteins and Carbohydrates.

4. Students will learn about basics of phase equilibrium and solutions.

**Mode of Transaction for the Paper:**

• Discussions

• Lectures and class assignments

• YouTube Lectures and Presentations

**Course Outcomes:**

After Completion of this course the student would be able to

* Explain the preparation & various chemical reactions of Amines, Nitro compounds & Diazonium salt.
* Explain the concept of Electrolytic conductance and oxidation & reduction potential.
* Explain the process of osmosis and other properties of solutions like elevation in boiling point & depression in freezing point
* Describe various kinds of carbohydrates & their configuration, their inter conversion by chain lengthening & shortening.
* Explain structure of protein and importance of amino acids for living organisms.

**Suggested Readings:**

**TEXT BOOKS:**

1. Graham Solomon, T.W., Fryhle, C.B., & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014)

2. Glasstone, S., An Introduction to Electrochemistry (2011) Read Books Limited.

3. Castellan, G.W., (2004) Physical Chemistry, Narosa

4. Brown, T.A. (2018) Biochemistry, (First Indian Edition 2018) Viva Books

**Teaching Plan for the Academic Session 2023-24**

**Teacher: Hemant Kumar , Class: B.Sc., Semester: 4th**

| **Week** | **Concept Breakdown** |
| --- | --- |
| **Week 1**  **01.02.2024 to 03.02.2024** | Amies: Strucutre & Nomenclature of amines, physical properties, Basicity of amines. Preparation of alkyl & aryl amines. |
| **Week 2**  **05.02.2024**  **To**  **10.02.2024** | Chemical reactions of Amines. Diazonium Salts: Mechanism of diazotisation, Strucutre of benzene diazonium chloride. Replacement of diazo group by various groups, Reduction of diazonium salts to hydrazines, coupling reaction and its synthetic application. |
| **Week 3**  **12.02.2024**  **to 17.02.2024** | Nitro compounds: Preparation f nitro alkanes & nitro arenes and their chemical reactions, electrophilic substitution reaction & reduction of nitro arenes. |
| **Week 4**  **19.02.2024**  **to**  **24.02.2024** | Electrochemistry: Electrolytic conduction, factors affecting electrolytic conduction, Specific, molar & equivalent conductance, Relation between these, their variation with concentration, Arrhenius theory of ionisation, Ostwald dilution law and Debye Huckle – Onsager’s equation for strong electrolyte. |
| **Week 5**  **26.02.2024**  **to**  **02.03.2024** | Kohlarausch’s law & its application, Applications of conductivity measurements, conductometric titrations, Definition of pH & pKa, Buffer solution, Henderson – Hazel equation, Buffer mechanism of buffer action. |
| **Week 6**  **04.03.2024**  **To**  **09.03.2024** | Electrochemistry II: Electroytic & galvanic cell – reversible & irreversible cells, conventional representation of electrochemical cells. EMF of cell & its measurement, activity & activity coefficients. Calculations of thermodynamic quantities of cell reaction. Types of reversible electrodes. Nernst equation, derivation of cell EMF and single electrode potential. |
| **Week 7**  **11.03.2024**  **to**  **16.03.2024** | Standard Hydrogen electrode, reference electrodes, standard electrode potential, sign conventions, electrochemical series & its applications. Application of EMF measurement, potentiometric titration. Determination of pH using Hydrogen electrode & glass electrode |
| **Week 8**  **18.03.2024**  **to**  **22.03.2024** | Solutions: Dilute solutions and colligative properties, ideal & non ideal solutions, activity & activity coefficient, Raoult’s law, relative lowering of vapour pressure, elevation in boiling point & depression of freezing point. |
| **Week 9**  **01.04.2024 to**  **06.04.2024** | Osmosis, molecular weight determination, thermodynamic derivation of relation between molecular weight and elevation in boiling point & depression in freezing point. |
| **Week 10**  **08.04.2024**  **to**  **13.04.2024** | Phase equilibrium: Phase component & degree of freedom, thermodynamic derivation of Gibbs phase rule, phase equilibria of one component system – water, carbon dioxide, & sulphur systems. Phase equilibria of two component systems, solid-liquid equilibria, simple eutectic example Pb-Ag system. |
| **Week 11**  **15.04.2024**  **to**  **20.04.2024** | Carbohydrates: Classification & nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose & fructose, chain lengthening & shortening of aldoses. Configuration of monosaccharides. |
| **Week 12**  **22.04.2024**  **to**  **27.04.2024** | Erythro & Threo diastereomers. Formation of glycosides, ethers & esters. Determination of ring size of glucose & fructose. Open chain & cyclic structure of D (+)-glucose & D (-)-fructose. Mechanism of mutarotation. Structure of ribose & deoxyribose. |
| **Week 13**  **29.04.2024**  **to**  **30.04.2024** | Amino Acids, Peptides & Proteins: Classification of amino acids, acid-base behaviour, isoelectric point & electrophoresis. Preparation of a-amino acids. Structure & nomenclature of peptides & proteins. Classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides, Classical peptide synthesis, structure of peptides & proteins. |

**Name: Hemant Kumar Signature**

**Assistant professor**

**Chemistry**