

Semester-II
PAPER Title: Major Paper -2 (MJ-2)
Credits - 03

Learning objective:

- Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
- Stereochemistry of organic molecules.
- Aromatic compounds and Aromaticity, mechanism of aromatic reactions
- Electrophilic, Nucleophilic, free radicals, electro negativity, resonance, and intermediates along the reaction pathways.

Organic Chemistry - 1

FM-60 Marks

Time 3hrs

| Unit | Content | Hours |
|------|---|-------|
| 1 | Basics of Organic Chemistry: Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electrometric, resonance and mesmeric effects, hyper conjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophilic and Nucleophilic; Nucleophilicity and basicity; Types, shape and relative stabilities of reaction intermediates (Carbocations, Carbanions, Free radicals and Carbenes). Organic reactions and their mechanism: Addition, Elimination and Substitution reactions. | 10h |
| 2 | Isomerism: Structural & Stereoisomer Concept of asymmetry, Fischer Projection, Newman and Sawhorse projection formulae and their interconversions; Geometrical isomerism: cis-trans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centers, Di stereoisomers, meso structures, Racemic mixtures, Relative and absolute configuration. | 10h |
| 3 | Chemistry of Aliphatic Hydrocarbons Alkanes and Cycloalkanes Formation of Alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free radical substitutions: Halogenations - relative reactivity and selectivity. Cycloalkanes and Conformational Analysis Cycloalkanes and stability, Baeyer strain theory, Conformation analysis, Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms. Alkene, Diene and Alkynes Formation of alkenes and alkynes by elimination reactions, Mechanism of E ₁ , E ₂ , E ₁ cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff's & Anti Markownikoff's addition), mechanism of oxymercuration demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2- and 1, 4- addition reactions in conjugated Dienes and, Diels- Alder reaction; Allylic and benzylic bromination and mechanism, e.g., propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. | 15h |
| 4 | Arenes and Aromaticity Aromaticity: Huckel's rule, aromatic character of arenes, cyclic Carbocations/carbanions and heterocyclic compounds with suitable examples. Nomenclature of benzene derivatives. The aryl group Aromatic nucleus and side chain. Electrophilic aromatic substitution: halogenations, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of substituent groups. Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure. MO picture. | 10h |

Sessional Internal Assessment (SIA) Full Marks – 15 Marks

A – Internal written Examination – 10 Marks (1 Hr)

B – Over All Performance including Regularity – 05 Marks

Books Recommended:

- Advanced Organic Chemistry by Bahl and Bahl
- Pradeep's Organic Chemistry by Pradeep Publication
- Dinesh Organic Chemistry
- Text Book of Organic Chemistry, Vol.- I and II by I.L. Finar
- Text Book of Organic Chemistry, Vol.- I and II by P.L. Soni
- Reactions and Reagents by O.P. Agarwal
- Reactions and Reagents by Gurdeep Raj Chatwal.
- Organic Chemistry by Morrison and Boyd

Semester-II
PAPER Title: Major Paper-3 (MJ-3)
Credits - 03

Learning objective:

- Familiarization with various states of matter
- Understanding Kinetic model of gas and its properties
- Ionic equilibria – electrolyte, ionization, dissociation

Physical Chemistry - 1

| FM- 60 Marks | Time 3hrs | Hours |
|---------------------|---|--------------|
| Unit | Content | |
| 1 | Gaseous state Behavior of real gases: Deviations from ideal gas behavior, compressibility factor, and its variation with pressure for different gases. Causes of deviation from ideal behavior. Van der Waals equation of state, its derivation and application in explaining real gas behavior, Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, critical and van der Waals constants, law of corresponding states. | 10h |
| 2 | Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η ; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy. | 10h |
| 3 | Liquid state: Structure and physical properties of liquids; vapor pressure, surface tension, viscosity, and their dependence on temperature, Effect of addition of various solutes on surface tension, cleansing action of detergents. Structure of water. | 05h |
| 4 | Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di- and tri-protic acids. Salt hydrolysis, hydrolysis constants, degree of hydrolysis and pH for different salts. Buffer solutions; Henderson equation, buffer capacity, buffer range, buffer action, applications of buffers in analytical chemistry, Solubility and solubility product. Bronsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, leveling solvents, Lewis's acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolytes. | 10h |
| 5 | Solid state: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, Various types of defects in crystals, Glasses and liquid crystals. | 10h |

Sessional Internal Assessment (SIA) Full Marks – 15 Marks

A – Internal written Examination – 10 Marks (1 Hr.)

B – Over All Performance including Regularity – 05 Marks

Books Recommended:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
- 5 G. M. Barrow, Tata McGraw Hill (Fifth Edition) (2007)
- 6 Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- 7 Roy, B. N. Fundamentals of Classical and Statistical Thermodynamics Wiley, 2001

Semester-II

PAPER Title: Chemistry Practical - MJ-2 LAB

Credits - 02

FM-50 Marks

Pass Marks – 20

Time: 03 hrs

Content

1. Detection of element [N, S, P and halogens] and detection of functional group in organic compounds containing one functional group including monosaccharides. COOH, Phenolic – OH, Aldehydic, Ketonic, Nitro, Amino and amides.
2. **Surface tension measurements.**
 - a. Determine the surface tension by (i) drop number (ii) drop weight method.
 - b. Study the variation of surface tension of detergent solutions with concentration.
3. **Viscosity measurements using Ostwald's viscometer.**
 - a. Determination of viscosity of aqueous solutions of
 - (i) polymer
 - (ii) ethanol and
 - (iii) sugar at room temperature.
 - b. Viscosity of sucrose solution with the concentration of solute.
- **pH metry**
 - a. Effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
 - b. Preparation of buffer solutions of different pH
 - I. Sodium acetate-acetic acid
 - ii. Ammonium chloride-ammonium hydroxide
 - c. pH metric titration of
 - (I) strong acid vs. strong base,
 - (ii) Weak acid vs. strong base.
 - d. Determination of dissociation constant of a weak acid.

One Experiment – 30 Marks

Viva-Voice – 10 Marks

Notebook & Regularity – 10 Marks