Program Outcomes (PO) for Under Graduate Programmes in subject of Chemistry.

PO1	Knowledge	Capable of demonstrating comprehensive disciplinary knowledge gained during course of study
PO2	Communication	Ability to communicate effectively on general and scientific topics with the scientific community and with society at large
PO3	Problem Solving	Capability of applying knowledge to solve scientific and other problems
PO4	Individual and Team Work	Capable to learn and work effectively as an individual , and as a member or leader in diverse teams, multidisciplinary settings
PO5	Investigation of Problems	Ability of critical thinking, analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions
PO6	Modern Tool usage	Ability to use and learn techniques, skills and modern tools for scientific practices
PO7	Science and Society	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices
PO8	Life-Long Learning	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life
PO9	Environment and Sustainability	Ability to design and develop modern systems which are environmentally sensitive and to understand the importance of sustainable development
PO10	Ethics	Apply ethical principles and professional responsibilities in scientific practices

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Ist Year (Ist Semester)

MAJOR CHEMISTRY SEMESTER I

COURSE OUTCOME: After completing this course, the learner will be able to:

1. Enable to understand the basis of quantum mechanics
2. and structural idea and relevance in describing shapes of s, p and d orbitals.
3. To learn about role of temperature and pressure to establish the state of gases and describe the
4. concept of critical constants of real gases.
5. Get knowledge about the electrophile/nucleophile andits role in mechanism of preparation of organic compounds.
6. To know the physical properties, morphology and crystalline study of liquid and different type of solids
7. Hand on practice in preparation of solutions, compounds, estimation and determination of
8. physical properties of some compounds.

SYLLABUS OF MAJOR CHEMISTRY SEMESTER I

Atomic Structure

Dual behaviour of matter and radiation, de Broglie's relation, Heinsenberg's uncertainty principle, concept of atomic orbitals, significance of quantum numbers, radial and angular wave functions, normal and orthogonal wave functions, significance of Ψ and Ψ2 , shapes of s, p, d, f orbitals, Rules for filling electrons in various orbitals, effective nuclear charge, Slater's rules.

Periodic table and atomic properties

Classification of periodic table, definition of atomic and ionic radii, ionisation energy, electron affinity and electronegativity, trend in periodic table (in s and p-block elements), Pauling, Mulliken, Allred Rachow and Mulliken Jaffe's electronegativity scale, Sanderson's electron density Ratio.

Gaseous State

Kinetic theory of gases, Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity, and most probable velocity. Collision diameter, collision number, collision frequency and mean free path (Derivations excluded), Deviation of Real gases from ideal behaviour, Derivation of Van der Waal' s Equation of State, its application in the calculation of Boyle' s temperature (compression factor)

Critical Phenomenon

Concept of Critical temperature, critical pressure, critical volume, relationship between critical constants and Van der Waal' s constants (Derivation excluded).

Structure and Bonding
Localized and delocalized chemical bond, Van der Waals interactions. Concept of resonance and its applications, hyperconjugation, inductive effect, Electromeric effect and their comparison.

Mechanism of Organic Reactions
Curved arrow notation, homolytic and heterolytic bond fission. Types of reagents: electrophiles and nucleophiles. Types of organic reactions: Substitution, Addition, Condensation, Elimination, Rearrangement, Isomerization and Pericyclic
reactions. Reactive intermediates: Carbocations, carbanions, free radicals, carbenes (structure & stability).

IV
Liquid State
Structure of liquids, Properties of liquids – surface tension, refractive index, viscosity, vapour pressure and optical rotation.

Solid State
Classification of solids, Law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry and symmetry elements, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a
simple account of Laue method, rotating crystal method and powder pattern method.

CHEMISTRY PRACTICAL SEMESTER I

1. **Acid/Base titration:** Determination of strength of oxalic acid using NaOH.
2. **Redox titrations:** Determination of Fe2+ ions usingKMnO4.
3. To determine the surface tension of given liquid using Stalagmometer by drop no. methods.
4. Preparation of *m*-Dinitrobenzne from Nitrobenzene (use 1:2 conc. HNO3-H2SO4 mixture if fuming HNO3 is not available)

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COURSE OUTCOME FOR MINOR CHEMISTRY SEMESTER I

After completing this course, the learner will be able to:

1. To understand the basics of Covalent bonding in simple molecules.
2. To get the basics of rates of chemical reactions and factors affecting it.
3. To learn about the nomenclature, classification and methods of preparation of alkenes.
4. To learn about qualitative knowledge of conductors, semiconductors and insulates.

MINOR CHEMISTRY SEMESTER I SYLLABUS

Covalent Bond

Valence bond theory approach, shapes of simple inorganic molecules and ions based on valence shell electron pair repulsion (VSEPR) theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral
arrangements. Molecular orbital theory of homonuclear (N2, O2) and heteronuclear (CO and NO) diatomic molecules, dipole moment and percentage ionic character in covalent bond.

II

Chemical Kinetics

Concept of reaction rates, rate equation, factors influencing the rate of reaction, Order and molecularity of a reaction, integrated rate expression for zero, first, second order
reactions (for equal conc. of reactants), Half-life period of a reaction.

III

Alkanes (upto 5 carbon atoms)

Alkanes, nomenclature, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation: Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids, physical properties. Mechanism of free radical halogenation of alkanes: reactivity and selectivity.

IV

Metallic Bond and semiconductors

Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators). Semiconductors – Introduction, types, and applications.

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11/8/23

COURSE OUTCOME MAJOR CHEMISTRY SEMESTER II

After completing this course, the learner will be able to:

1. Able to understand the theories which governs the shape, structure and ionic behavior, polarizability, ionic structures and concept of Lattice energy of crystals of molecules.
2. To know the basics of rates of chemical reactions ,the laws and solubility behavior of solutes in different compositions of solvents
3. To know about alkanes, alkene, cycloalkanes and their chemical reactions.
4. To understand about weak interactions and bonding in metals.
5*. Hand on practice for estimation and determination of viscosity, specific refractivity properties of some compounds.

SYLLABUS MAJOR CHEMISTRY SEMESTER II

Covalent Bond

Valence bond theory approach, shapes of simple inorganic molecules and ions based on valence shell electron pair repulsion (VSEPR) theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Molecular orbital theory of homonuclear (N2, O2) and heteronuclear (CO
and NO) diatomic molecules, dipole moment and percentage ionic character in covalent bond.

Ionic Solids

Ionic structures (NaCl, CsCl, ZnS (Zinc blende), CaF2) size effects, radius ratio rule and its limitations, Concept of Lattice energy, Born- Haber cycle, Solvation energy and its
relationship with solubility of Ionic solids, Polarizing power and Polarisability of ions, Fajan's rule.

II

Chemical Kinetics

Concept of reaction rates, rate equation, factors influencing the rate of reaction, Order and molecularity of a reaction, integrated rate expression for zero, first, Half-life period of a reaction, Arrhenius equation.

Distribution Law

Nernst distribution law – its thermodynamic derivation, Nernst distribution law after association and dissociation of solute in one of the phases, of distribution law: (i)
Determination of degree of hydrolysis and hydrolysis constant of aniline hydrochloride

III

Alkanes and Cycloalkanes

Nomenclature, classification of carbon atoms in alkanes and its structure. Isomerism in alkanes, sources. Methods of formation: Wurtz reaction, Kolbe reaction, Corey- House reaction and decarboxylation of carboxylic acids, physical properties. Mechanism of free radical halogenation of alkanes: reactivity and selectivity.
Nomenclature of Cycloalkanes, Baeyer' s strain theory and its limitations, theory of strainless r ings.

Alkenes

Nomenclature of alkenes and its structure. Methods of formation: dehydration of alcohols, dehydrohalogenation of alkyl halide, Hofmann elimination and their mechanism. The
Saytzeff rule and relative stabilities of alkenes. Chemical reactions: electrophilic and free radical additions, addition of halogens, halogen acids, hydroboration–oxidation,
oxymercuration-reduction, ozonolysis and hydration. Markownikoff's rule of addition.

IV

Hydrogen Bonding and Van der Waals forces

Hydrogen Bonding – Definition, types, effects of hydrogen bonding on properties of substances, applicatio
Brief discussion of various types of Van der Waals forces.

Metallic Bond and semiconductors

Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors,insulators).
Semiconductors – Introduction, types, and applications.

1. **Complexometric titrations:** Determination of Mg^{2+} by EDTA.
2. **Paper Chromatography:** Qualitative Analysis of any one of the following Inorganic cations and anions by paper chromatography (Pb^{2+}, Cu^{2+}, Ni^{2+}, Cl^- , Br^- , and PO_4^{3-} and NO_3^-).
3. To determine the viscosity of given liquid using Ostwald's Viscometer.
4. To determine the specific refractivity of at least two liquids by Refractometer.
5. Separation of mixture of two Organic Compounds by TLC.

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MINOR CHEMISTRY SEMESTER II

COURSE OUTCOME:

After completing this course, the learner will be able to:
1. To know the basics of periodic properties and hybridization.
2. To learn about the ionic solids.
3. Understand about the semiconductors and metallic bonds.
4. Get the knowledge of stereochemistry of simple organic molecules.

MINOR CHEMISTRY SEMESTER II SYLLABUS:

Periodic table and atomic properties

Atomic properties: atomic and ionic ràdii, ionisation energy, electron affinity and electronegativity definition, methods of determination or evaluation, trend in periodic table, effective nuclear charge, Slater's rules. Directional characteristics of covalent bond, various type of hybridisation and shapes of simple inorganic molecules and ions (BeF2, BF3, CH4, PF5, SF6, IF7, SO4 -2 , ClO4 -1 , NO3 -1

II

Ionic Solids:

Stoichiometric and Non-stoichiometric defects in crystals, Lattice energy and Born- Haber cycle, Solvation energy and its relationship with solubility of Ionic solids, Polarizing power and Polarisability of ions, Fajan's rule. Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators)

III

Metallic Bond and semiconductors

Semiconductors – Introduction, types, and applications. Structure and Bonding in Organic Compounds Localized and delocalized chemic al bond, Van der Waal's interactions, resonance: conditions, resonance effect and its applications, hyperconjugation, inductive effect, Electromeric effect & their comparison.

IV

Stereochemistry of Organic Compounds

Concept of isomerism. Types of isomerism. Optical isomerism, element s of symmetry, enantiomers, stereo genic centre, optical activity, properties of enantiomers, chiral and achiral molecules (upto two stereo genic centres), diastereomers, threo and erythro diastereomers, meso compounds Relative and absolute configuration, sequence rules, R & S systems of nomenclature. Geometrical isomerism. Determination of configuration of geometric isomers.

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