DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
LUCKNOW
Four Year Undergraduate Course Structure
Subject: Chemistry Semester I

Paper	Major Branch	Type	Credits	Total Credits
Paper 1 (P1)	Inorganic Chemistry 1	Theory	4	4
Paper 2 (P2)	Organic Chemistry 1	Theory	4	4
CC 1	Co-Curriculum	Language	4	4
Paper 2 (P1")	Organic Chemistry 1	Minor Theory	4	4
P1'	Second major subject	Theory	4	4
P2'	second major subject	Theory	4	4
	Total Credits			**24**

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Subject: Chemistry Semester I

Inorganic Chemistry 1

Semester I **Paper – 1 (P1)** **Credits 4**

Course outcome

Students admitted in B.Sc. Chemistry semester program will gain precise insight into the:

CO-1 Structure of atoms and associated important rules, importance of chemistry of elements.

CO-2 Ionic, covalent and non-covalent bonding which always play pivotal role in deciding the chemistry and properties of any compound/material.

CO-3 Periodic properties of elements and several parameters associated with elements

CO-4 Solid state chemistry which forms the basis of the development of targeted crystalline solids inculcating varied defects which induces variety of materials properties viz. piezoelectricity.

CO-5 Chemistry of elements belonging to s-block, noble gases and main group.

Unit I

I. Atomic Structure: Quantum mechanics-based structure of atom in brief, shapes of s, p and d orbitals, Aufbau and Pauli exclusion principles, Hund's Multiplicity rules. Electronic configurations of the elements, effective nuclear charge.

II. Periodic Properties and Classification based upon electronic configuration: Diagonal relationship, inert pair effect, atomic and ionic radii, van der waal radii, ionization energy,

III. Electron affinity and electronegativity: definition, method of determination, trends in periodic table and applications in predicting and explaining chemical behaviour.

Unit II

IV. Chemical Bonding

(a) Covalent bond: valence bond theory and its limitations, directional characteristic of covalent bond. Hybridization and shapes of simple molecules and ions. Valence Shell Electron Pair Repulsion (VSEPR) theory to simple molecules and ions. Molecular Orbital theory for homonuclearand heteronuclear (CO and NO) diatomic molecules, multi-center bonding in electron deficient molecules, bond strength and the bond energy, % ionic character from dipole moment and electro
negativity difference.

(b) Weak interactions: hydrogen bonding, van der Waals forces.

Unit III

V. Ionic solid: ionic structures, radius ratio effect and coordination number, limitation of ratio rule, Lattice defects, Lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions. Fajan's rule, Metallic bond free electron, Valence bond and Band theories.

VI. s-Block elements: Comparative study, salient features of hydrides, salvation and complexation tendencies of cations of alkali and alkaline earth matter including their function in biosystems, an introduction to alkyls and aryls of Li & Mg.

VII. Noble Gases: Chemical properties of the noble gases, discovery of $O_2^+PtF_6^-$ and O_2XeF_6.Chemistry of xenon, structure and bonding in xenon compounds.

Unit IV

VIII. p-Block Elements:- Comparative study (including diagonal relationship) physical and chemical behaviour of group 13-17 elements, compounds like hydrides, oxides, oxyacids and halides ofgroup 13-16, diborane, boronitride α, β forms, Fullerenes, silicates(structural principle) andstructures of oxides and oxyacids of phosphorus and sulphur, interhalogens and polyhalides.

Text Books (Theory Courses):

(a) Concise Inorganic Chemistry, J.D. Lee, Blackwell Science Ltd.
(b) Inorganic Chemistry, Puri, Sharma, Kalia and Kaushal.
(c) Pradeep's Inorganic Chemistry, K.K. Bhasin, Pradeep Publication.
(d) Chemistry for degree students, R. L. Madan

Reference Books:

(a) Inorganic Chemistry, J.E.Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.
(b) Inorganic Chemistry, D.E.Shriver, P W. Atkins and C.H.L. Langford, Oxford.
(c) Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
(d) Concepts of Models of Inorganic Chemistry, B.Douglas, D.McDaniel and J Alexander, John Wiley.
(e) Inorganic Chemistry, W.W. Porterfield, Addison - Wesley.
(f) Inorganic Chemistry, A.G. Sharpe, ELBS
(g) Inorganic Chemistry, G.L. Meissler and D.A. Tarr, Prentice-Hall.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
LUCKNOW
Four Year Undergraduate Course Structure
Subject: Chemistry Semester I
Organic Chemistry 1 (Major P2 and Minor P1")

Semester I **Paper – 2** **Credits 4**

Course outcome

Upon successful completion of this course, the student will be able to

CO-1 Understand different organic compounds with respect to the functional group and thus capable to name the organic compounds as per IUPAC nomenclature.

CO-2 Understand the basics of chemical reactions i.e. Substrate and Reagent, types of Reagents, Electrophilic and Nucleophilic Homolytic and heterolytic fission. Electron mobility, Inductive effect etc.

CO-3 Recognize and draw constitutional isomers, stereoisomers, including enantiomers and diasteromers, racemic mixture and meso compounds.

CO-4. Understand fundamental principles of organic chemistry and predict outcomes and derive mechanism of various types of organic reactions.

CO-5 Understand various types of reactive intermediates and factors affecting their stability

CO-6 Understand the nomenclature, synthesis, isomerism and physical properties of alkanes and cycloalkanes.

CO-7 Understand the concept of Aromaticity of benzenoids & non-benzenoids, the preparation, reactivity & structure of aromatic compounds.
CO-8 Learn the preprations, reactivity & stereochemistry of SN1 &SN2 reactions of Halogen compounds.

Unit I

I. Structure and bonding: bond lengths, bond angles, bond energy, localised and delocalized π bonds, resonance, inductive and field effects, steric effect, tautomerism, inclusion compounds, clathrates, charge transfer complexes, van der Waals interaction, hyperconjugation, aromaticity.

II. Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with arrows, half headed and double-headed arrows, Reactive intermediates-generation, structure, stability and reactions of carbocation, carbanion, free radicals and carbenes, Arynes, Nitrenes.

III. Types of organic reactions-addition, elimination, substitution, rearrangement, condensation, methods of determination of reaction mechanism (product analysis, intermediates, isotopic effects, kinetic and stereochemical studies). Energy considerations.

Unit II

IV. Stereoisomerism

Optical isomerism: Elements of symmetry, molecular chirality, optical activity, stereogenic centres, enantiomers, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers,

inversion, retention and racemization. Relative and absolute configurations. Sequence rules. D, L and R, S nomenclature.

Geometrical isomerism: determination of configuration of geometric isomers. E, Z system, geometrical isomerism in oximes and alicyclic compounds. Conformational isomerism-Conformational analysis of ethane and n-butane and cyclohexane, axial and equatorial bonds, Saw-horse and flying wedge formulae, Fischer and Newman projections formulae. Difference between conformation and configuration.

Unit – III

V. Alkanes And Cycloalkanes: Methods of formation with special reference to Wurtz, Kolbe, Corey-House reactions and decarboxylation. Physical properties and chemical reactions. Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

Cycloalkanes: Nomenclature, methods of preparation. Baeyer's strain theory and its limitations. Ring strain in (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring and banana bond.

VI. Alkenes, Cycloalkenes, Dienes: methods of formation. Mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides. Regio-selectivity in alcohol-dehydration. Saytzeff's rule, Hofmann elimination. Physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- Mechanisms involved in hydrogenation, electrophilic and free-radical additions. Markownikoff’s rule. Hydroboration-oxidation, oxymercuration-reduction, epoxidation, ozonolysis, hydrations, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitutions at allylic and vinylic positions of alkenes.

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, chemical reaction – 1, 2 and 1, 4 additions, Diels-Alder reaction.

VII. Alkynes: Structure and bonding in alkynes. Methods of formation, chemical reactions and acidity of alkynes. Mechanism of electrophilic and mucleophilic addition reactions, hydroboration-oxidation, reductions and oxidation reactions.

Unit IV

VIII. Arenes and Aromaticity: Nomenclature of benzene derivatives. Structure of benzene: molecular formula and Kekule structure. Stability and carbon carbon bond length of benzene, resonance structure, MO picture.

IX. Aromatic electrophilic substitution- general pattern of the mechanism, Arrhenium ion intermediate. Mechanism of nitration, halogenation, sulfonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activation and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction.

X. Alkyl and Aryl Halides: Methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams, Aryl halides - Methods of

formation, nuclear and side chain reactions. Mechanisms of nucleophilic aromatic substitutions.

Text Books (Theory Courses):

(a) Organic Chemistry, Vol. I, I.L. Finar, Pearson Education.
(b) Organic Chemistry, M.K. Jain, Shoban Lal& Co.
(c) Pradeep's Organic Chemistry, S.N. Dhawan, Pradeep Publication.

Reference Books:

(a) Organic Chemistry, Morrison and Boyd, Prentice Hall.
(b) Organic Chemistry, L.G. Wade Jr. Prentice Hall.
(c) Fundamentals of Organic Chemistry Solomons, John Wiley.
(d) Organic Chemistry, Vol. I, II, III S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
(e) Organic Chemistry, F.A. Carey, McGraw-Hill Inc.
(f) Introduction to Organic Chemistry, Streitwiesser, Hathcock and Kosover, Macmillan.