

Semester-I
Interdisciplinary Course 1 (ID-1):
Fundamentals of Chemistry
Credits: 03
Full Marks: 100

Unit I: Atomic Structure and Periodicity of Elements (12L×45 minutes)

Bohr's theory of atomic structure and its limitations, spectrum of hydrogen atom; de Broglie equation, Heisenberg's Uncertainty Principle and its significance. Shapes of s, p, d and f orbitals. Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations.

Periodic classification of elements on the basis of electronic configuration; Periodic properties – atomic radii, ionic radii, covalent radii; electron affinity, electronegativity, ionization enthalpy, factors affecting electron affinity and ionization enthalpy, applications of ionization enthalpy.

Unit II: Basics of Organic Chemistry (12L×45 minutes)

Concept of hybridization, hybrid orbitals and molecular geometry, bond lengths, bond angles, bond energy, localized and delocalized chemical bonding, van der Waals interactions, Dipole moment; Electronic displacements: Inductive effect, resonance, mesomeric effects, hyper conjugation and their applications; acidity and basicity of organic compounds; Mechanism of Organic Reactions: homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, examples of reactive intermediates – carbocations, carbanions, free radicals.

Unit III: Chemical Equilibrium (12L×45 minutes)

Equilibrium constants and free energy, thermodynamic derivation of law of mass action. Le-Chatelier's principle, reaction isotherm and reaction isochore– Clapeyron- Clausius equation and its applications.

Unit IV: Ionic Equilibrium (12L×45 minutes)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionizations of weak acids and bases, pH scale, common ion effect. Salt hydrolysis, Buffer solutions, applications of buffer solutions.

Recommended books:

1. Lee, J.D. *Concise Inorganic Chemistry*, Pearson Education 2010.
2. *Selected Topics in inorganic Chemistry*, Madan, Tuli
3. Singh J., Yadav L. D.S., *Advanced Organic Chemistry*, Pragati Edition
4. Morrison, R.N. & Boyd, R.N. *Organic Chemistry*, Pearson Education.
5. Sykes, P. *A guidebook to Mechanism in Organic Chemistry*, Pearson Education, 2003
6. P.C. Rakshit, *Physical Chemistry*

Semester-III
Interdisciplinary Course 1 (ID-2)
Bimolecular Chemistry
Credits: 03, Full Marks: 100

Unit I: Carbohydrates, Fats, oils and lipids

(12L×45 minutes)

Introduction and classification of carbohydrates; general properties of glucose and fructose, their open chain and cyclic structure; epimers and anomers; mutarotation, structure of disaccharides (sucrose, maltose, lactose); metabolism of glucose. Detection of carbohydrates. Introduction to oils, fats and fatty acids; classification of lipids, common fatty acids present in oils and fats, biological importance of fatty acids and lipids, essential fatty acids: ω -3 and ω -6 fatty acids; mono and polyunsaturated fatty acids and their significance.

Unit II: Amino acids & Proteins

(12L×45 minutes)

Introduction, classification of α -amino acids, Zwitter ion structure and isoelectric point; single and three letters code of amino acids; essential and non-essential amino acids; introduction on peptides, hydrolysis of peptides; overview of primary, secondary, tertiary and quaternary structure of proteins; protein de-naturation/renaturation.

Unit III: Enzymes

(12L×45 minutes)

General aspects of enzymes, nomenclature, classification and specificity, function of enzymes. Factors affecting enzyme action, co-enzymes and cofactors and their role in biological reactions, enzyme regulation & drug design, Fischer's lock and key hypothesis of enzymes activity. Some common digestive enzymes, intra-cellular and extracellular enzymes. Enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).

Unit IV: Bioinorganic Chemistry

(12L×45 minutes)

Essential metal ions present in biological systems and their role, classification of elements according to their action in biological system, structure and function of biological membranes, active transport of cations across membrane, crown ether complexes of Na and K, ionophores, Sodium/Potassium pump; carbonic anhydrase and carboxypeptidase. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, use of chelating agents in medicine; Pt-complexes as anticancer drugs, Iron and Haemoglobin.

Recommended books:

1. *Advanced General Organic Chemistry* by Sachin Kumar Ghosh
2. *Nelson, D.L. & Cox, M.M. Lehninger Principles of Biochemistry*, W.H. Freeman, 2013.
3. *Organometallic and Bioinorganic Chemistry* by Ajay Kumar

Semester-IV
Interdisciplinary Course 1 (ID-3)
Chemistry in Application
Credits: 03, Full Marks: 100

Unit I: Polymers

(12L×45 minutes)

Introduction, classification of polymers (based on source and structure): cellulose, cotton, wool, silk, paper, thermosetting polymers and thermoplastic polymers. polythene, polystyrene, PAN, PVC, PTFE, synthetic rubber, Buna-S, Buna-N, Tyrelene, Glyptal, Nylon-66, Nylon-6,10, melamine, bakelite – their monomers and uses. Bio-degradable polymers, PHBV, Polyglycolic acid-Polylactic acid, Nylon2,6. Recycling of polymers and recycle codes.

Unit II: Medicinal Chemistry

(12L×45 minutes)

Concepts of drugs, classification of drugs, drug discovery, drug design and drug development; analogues and pro-drugs, soft drugs, ADME; drugs and medicines, Synthesis and applications of aspirin, paracetamol, chloramphenicol, sulphonamides, elementary concept on antibiotics; broad spectrum and narrow spectrum antibiotics. Medicinal values of curcumin (haldi), azadirachtin (neem), piperine (black pepper), vitamin C and essential oils.

Unit III: Chemistry in everyday life I

(12L×45 minutes)

Cosmetics and perfumes:

A general study including uses of the following: Hair dye, hair spray, shampoo, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams).

Soap and detergents:

Soaps, detergents, properties of soap, soaps for different purposes- laundry soaps, toilet soaps, liquid soaps, transparent soaps, baby soaps, shaving soaps, medicated soaps. biodegradability of detergents, green detergents.

Shampoos: Ingredients and functions, different kinds of shampoos, Anti-dandruff, antilice, herbal and baby shampoos. Health effects of shampoos.

Unit IV: Chemistry in everyday life II

(12L×45 minutes)

Food preservatives and additives: Classification, chemical composition and food preservation and processing. Permitted food additives and their roles: antioxidants, colouring agents, sweeteners and dyes as food additives.

Fertilizer: General principles of plant nutrition: essential plant nutrients, functions of the essential elements, classification of commercial nitrogenous fertilizers viz. ammonium sulphate, urea, ammonia nitrate; phosphatic fertilizers viz. single super phosphate, triple superphosphate.

Recommended books:

1. K. J. Saunders, *Organic Polymer Chemistry, An Introduction to the Organic Chemistry of Adhesives, Fibres, Paints, Plastics and Rubbers*
2. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi, 2012*
3. B. K. Sharma, *Engineering chemistry, Krishna Prakashan Media.*
4. M. Ash, I. Ash, *Formulary of Detergents and Other Cleaning Agents, Chemical Publishing, 1999.*
5. Jain, P.C. & Jain, M. *Engineering Chemistry Dhanpat Rai & Sons, Delhi.*
6. Sharma, B.K. & Gaur, H. *Industrial Chemistry, Goel Publishing House, Meerut, 1996*