Course Structure for Gen Ed (B.Sc.) Chemistry

Semester	Course	Course Description(Marks)	Full Marks	Credit
First	GenED-1 CHEM 0131	Organic Chemistry-I	50	4
Second	GenED-2 CHEM 0231	Inorganic Chemistry-I	50	4
	GenED-3 CHEM 0232	Physical Chemistry-I	50	4
Third	GenED-4 CHEM 0331	Organic Chemistry-II	50	4
Fourth	GenED-5 CHEM 0431	Inorganic Chemistry-II	50	4
	GenED-6 CHEM 0432	Physical Chemistry-II	50	4
Grand Total			300	24

FIRST SEMESTER

Course No. GenED-1 CHEM 0131 (FM=50; C=4)

Organic Chemistry-I

Unit 1 (M = 30)

General introduction

Functional group based classification and nomenclature. Molecular formula and IHDIDBE.

Bonding

Concept of hybridisation, resonance (including hyperconjugation), orbital pictures of bonding (Sp3, sp', sp: C-C). Inductive effect, bond polarization and bond polarizability, steric effect, steric inhibition of resonance.

Streochemistry

Chirality, optical activity, symmetry elements (plane, centre) Stereo isomerism due to one and two stereocentres and descriptors; stereoisomerism in C=C system and descriptors.
Conformational analysis of ethane and butane

Physical properties

Mp/bp; solubility; dipole moment; acid and base strength.

Unit 2 (M = 20)

Organic reactions

Classification of reactions- substitution, addition, elimination, rearrangement. Alkanes, alkenes and alkynes: Synthesis and chemical reactivity of alkanes, mechanism of radical halogenation of alkanes, general methods of synthesis of alkenes, electrophilic addition reaction, mechanism of bromination and hydrohalogenation, Markownikoff's addition, peroxide effect, hydroboration, ozonide formation, polymerization reaction of alkenes (definition and examples only), general methods of synthesis, acidity, hydration and substitution reactions of alkynes.

Aromatic Hydrocarbons: mechanism of electrophilic substitution, synthesis of benzene deivatives using nitration, halogenation, Friedel-Craft's reactions. Nucleophilic aromatic substitution.

SECOND SEMESTER

Course No. GenED-2 CHEM0231 (FM = 50; C = 4)

Inorganic Chemistry-I

Unit 1 (M = 30)

Extra-nuclear Structure of atoms

Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many- electron atoms, *Aujbau* principle and its limitations.

Radioactivity

Natural radioactivity, units, radioactive disintegration series, group displacement law, law of radioactive decay, half-life of radio elements. Stability of atomic nucleus: *nip* ratio, nuclear binding energy, mass defect. Nuclear reactions: fission, fusion, transmutation of elements, artificial radioactivity, measurement of radiactivity (simple idea).

Chemical Periodicity

classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases. Atomic and ionic radii, ionization potential, electron affinity, and
electronegativity; periodic and group-wise variation of above
properties in respect of s- and p- block elements.

Unit 2 (M = 20)

Ionic bonding

General characteristics of ionic compounds, sizes of ions, radius ratio rule and its limitation. Lattice energy, Born Haber cycle.

Covalent bonding

General characteristics of covalent compounds, valence-bond approach, hybridization involving s-, p-, d-orbitals.Valence Shell Electron Pair Repulsion (VSEPR) concept, shapes of simple molecules and ions of main group elements, bond moment and dipole moment, partial ionic character of covalent bonds, Fajan's rules, hydrogen bonding and its effect on physical and chemical properties.

Coordinate bonds and Coordination compounds

Complex salts and double salts, Warner's theory of coordination, IUPAC nomenclature of coordination complexes (mononuclear complexes only), chelate complexes, stereochemistry of coordination numbers 4 and 6.

Course No. GenED-3 CHEM0232 (FM = 50; C = 4)

Physical Chemistry-I

Unit 1 (M = 20)

Gaseous state

Maxwell's distribution law of molecular speeds (without derivation), most probable, average and root mean square speed of gas molecules, principle of equipartition of energy (without derivation). Mean free path and collision frequencies. Heat capacity of gases (molecular basis); viscosity of gases.

Real gases, compressibility factor, deviation from ideality, van der Waals equation of state, critical phenomena, continuity of states, critical constants.

Liquid state

Physical properties of liquids and their measurements: surface tension and viscosity.

Unit 2 (M = 30)

Thermodynamics

Definition of thermodynamic terms: Intensive and extensive variables, isolated, closed and open systems. Cyclic, reversible and irreversible processes. Thermodynamic functions and their differentials. Zeroth law of thermodynamics, concept of heat (q) and work (w). First law of thermodynamics, internal energy (U) and enthalpy CH); relation between Cp and Cv, calculation ofw, q, L\U and *L\H* for expansion of ideal gas under isothermal and adiabatic conditions for reversible and irreversible processes including free expansion. J oule- Thomson Coefficient and inversion temperature. Kirchhoff's equation, relation between ~H and ~U of a reaction. Spontaneous processes, heat engine, Carnot cycle and its efficiency, Second law ofthermodynamics, Entropy (S) as a state function, molecular interpretation of entropy, entropy changes in simple transformations. Free energy: Gibbs function (G) and Helmholtz function (A), Gibbs-Helmholtz equation, criteria for thermodynamic equilibrium and spontaneity of a process.

THIRD SEMESTER

Course No. GenED-4 CHEM0331 (FM = 50; C = 4)

Organic Chemistry-Il

Unit 1 (M = 30)

Reaction and synthesis

Alkyl halides: SNl, SN2, El and E2 reactions (elementary mechanistic aspects), Saytzeff and Hoffmann elimination reactions.

Aldehydes and ketones: synthesis, reactions:Cannizzaro reaction,Aldol condensation, Perkin reaction, Benzoin condensation, Claisen condensation, haloforrn reaction, oxidation and reduction reactions.

Carboxylic acids and their derivatives: esterification of carboxylic acids and hydrolysis of esters (BAc2 and AAc2 only)

Phenols: Kolbe reactions, Reimer- Tiemann reaction, Fries rearrangement, Claisen rearrangement.

Grignard reagents - preparations and application in organic synthesis.

Amines: Hofmann degradation, Gabriel's phthalimide synthesis, distinction of primary, secondary and tertiary amines; aromatic diazonium salts and their synthetic uses.

Unit 2 (M = 20)

Biomolecules

Carbohydrates: classification of carbohydrates, Fischer configuration *(D/L)* ofaldoses (tetrose, pentose and hexose), fructose. Ring structure of ribose, glucose and fructose.

Mutarotation of glucose. Glycosidic linkage: sucrose, lactose. Reducing and non-reducing property.

Amino acids, peptides and proteins: natural amino acids and their structures, synthesis of alanine using Strecker synthesis. Zwitterion structures, isoelectric point.

Peptide linkage, structure of short peptides indicating N-terminal and C-terminal residues.

Proteins: primary, secondary, tertiary and quaternary structure

Heterocyclic compounds: structure (with numbering) of heterocycles: furan, pyrrole, thiophene, pyran, pyridine, indole, quinoline, isoquinoline, imidazole, oxazole, pyrimidine, purine.

Nucleic acids: structure of pyrimidine and purine bases; nucleosides, nucleotides, RNA and DNA.

FOURTH SEMESTER

Course No. GenED-5 CHEM0431 (FM = 50; C = 4)

Inorganic Chemistry-II

Unit 1 (M = 20)

Comparative study of p-block elements
Group trends in electronic configuration, common oxidation states, inert pair effect, and their important compounds in respect ofthe following groups of elements: i) B-AI-Ga-In- TI ii) C-Si-Ge-Sn-Pb iii) N-P-As iv) O-S v) F-Cl-Br-I

Unit 2 (M = 15)

Acid-Base concept
Arrhenius and Bronsted-Lowry's concept, relative strength of acids bases, amphoterism, Lux-Flood concept, Lewis concept. HSAB principle (qualitative idea).

Redox chemistry
Balancing of equations by ion-electron methods, elementary idea on standard redox potentials with sign convention, Nemst equation (without derivation). Influence of complex formation and change of pH on redox potentials, formal potential, feasibility of a redox titration, redox indicators, disproportionation and comproportionation reactions (typical examples).

Unit 3 (M = 15)

Ores and minerals (containing some typical non-transition, transition and inner transition elements).
Extraction, purification and uses of the following elements: Li, Si, Cr, Mn, Ni, Ag, Au, U.
Preparation, use and analytical application (if any) of the following compounds: $KMn0_4$ K_2Cr0_4, $K_2Cr_20_7$, $AgN0_3$·

Course No. GenED-6 CHEM 0432 (FM = 50; C = 4)

Physical Chemistry-II

Unit 1 (M = 30)

Chemical equilibrium: Chemical equlibria of homogeneous and heterogeneous systems, derivation of expression of equilibrium constants; temperature, pressure and concentration dependence of equilibrium constants (Kp, Kc' K_x); Le Chatelier's principle of dynamic equilibrium.

Ionic equilibrium
Ionization of weak acids and bases in aqueous solutions, application of Ostwald's dilution law, ionization constants, ionic product of water, pH-scale, buffer solutions and their pH values, buffer actions; hydrolysis of salts.

Solutions of electrolytes
Electrolytic conductance, specific conductance, equivalent conductance and molar conductance of

electrolytic solutions. Influence oftemperature and dilution on weak electrolytes.

Electrode potential
Electrode potentials, Nemst Equation, reference electrodes: normal hydrogen electrode and calomel electrodes, Emf of electrochemical cells and its measurement, electrode potential series and its applications.

Unit 2 (M = 20)

Chemical kinetics and catalysis
Order and molecularity of reactions, rate laws and rate equations for first order and second order reactions (differential and integrated forms); zero order reactions. Determination of order of reactions. Temperature dependence of reaction rate, energy of activation. Catalytic reactions: homogeneous and heterogeneous catalytic reactions, enzyme kinetics.

Colligative properties
Raoult's Law, relative lowering of vapor pressure, osmosis and osmotic pressure; elevation of boiling point and depression of freezing point of solvents.

Colloids
Classification of colloids, preparation and purification of colloids: ferric hydroxide sol and gold sol.
Properties of colloids:
Brownian motion, peptization, dialysis, Tyndal effect and its applications. Protecting colloids, gold number, isoelectric points, coagulation of colloids by electrolytes, Schulze- Hardy rule.