RESTRUCTURED INORGANIC SYLLABUS (CEMA)

SEM – I

(A) Atomic Structure (L)

H-Spectra; Wave mechanical model; de Broglie relation; Heisenberg Uncertainty Principle & its significance; Schrödinger Wave Equation (qualitative approach); Radial and Radial Probability Fuctions; Angular and angular probability functions (qualitative idea only); s, p and d – type atomic orbital envelope diagrams; nomenclature of atomic orbitals. Exchangeenergy, Hund'srule , limitations of Auf Bau Principle.

(B) Periodic Table (L)

Modern form of Periodic Table (IUPAC version), Nomenclature of Super-heavy elements (Z >100), screening effect and Slater's rules.
Inert Pair Effect, trends in atomic/ionic size, ionization energy, electronegativity and electron affinity of the s-, p-, d- and f- block elements, ionic potential and diagonal relationship in the Periodic Table. Scales of Electronegativity :MullikenScale, Pauling Scale and Alred–Rochow Scale. Variation of electronegativity with bond order and oxidation states.

(C) Radioactivity (L)

Atomic nucleus – nuclear stability, n/p ratio and different modes of decay, nuclear binding energy, nuclear forces, Meson field theory, Nuclear Shell Model (elementary idea) and magic numbers.
Nuclear reactions – nuclear fission, nuclear fusion, spallation and transmutation of elements.Uses of isotopes in Chemistry.

SEM – II

(A) Ionic Bonding (L)

Packing of ions in crystals, radius ratio rules – applications & limitations; lattice energy – Born- Lande' equation and its applications
Born-Haber Cycle and its applications; solvation energy, dissolution of ionic solutes in polar solvents;Polarizability&Fajan's Rules; Stoichiometric and non–stoichiometric defects in crystals (non – mathematical approach), Van der Waal's forces, Hydrogen bondingand its applications.

(B) Coordination Chemistry – I(L)

Double salts , Complex salts, Werner's Coordination Theory, mono- poly- and ambidentate ligands, Chelate complexes, Inner metallic complexes, IUPAC nomenclature of complexes, application of chelates in qualitative and quantitative chemical analysis.

(C) Covalent Bonding – I(L)

Formal Charge, VSEPR theory and structure of inorganic molecules, Berry pseudorotation, hybridization, Bent's rule, dipole moment, resonance.

SEM – III

(A) Redox Equilibrium (L)

Balancing redox reactions by the ion–electron method; Standard redox potential, Nernst equation, influence of pH, precipitation and complexation on redox potential, formal potentials, feasibility of redox titrations, redox potential at equivalent point, redox indicators;redox diagrams – Latimer and Frost diagrams of concerned elements and their applications (typical examples).

(B) Group Chemistry – I : Group 1 and 2 (L)

Solutions of alkali metals in liquid ammonia; complexation with crown–ethers, cryptands and related ligands; basic beryllium acetate; detection of metal ions – Na^{+}, K^{+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+} in qualitative analysis.

(C) Group Chemistry – II : Groups 13 & 14 (L)

General trends in the oxidation states, hydrides, oxides, halides of B, Al, Ga, In, Tl; special features in the chemistry of boron trihalides, diborane, boron nitride and borazine; General trends in the oxidation states, catenation property, hydrides, halides and oxides of C,Si,Ge,Sn,Pb; special features in the chemistry of graphite, fullerenes, silicates, silicones and chloroflurocarbons; ultra–pure silicon.

(D) Covalent Bonding – I (L)

Molecular orbital theory : Qualitative approach to molecular orbital theory; MO energy level diagrams of H_2, Li_2 to N_2, O_2, F_2, CO,NO,CN^{-}, HF, HF_2^{-}, BeH_2, CO_2.
Metallic bonding :qualititative treatment of Band Theory; conductors, semiconductors and insulators.

SEM – IV

(A) Definition of acids and bases; solvents (L)

Recapitulation of Arrhenius concept, Bronsted–Lowry definition, solvent system definition, Lux–Flood definition; Relative strength of hydracids, strength of oxoacids, Pauling's rules; HSAB principle, superacids; Solvent properties of water and liquid ammonia; reactions in liquid ammonia.

(B) Acid – Base equilibria(L)

pH (of strong acid/base solution and weak acid/basesolution), buffer solution, pH of a buffer solution, Hendersen'sequation, buffer capacity; salt hydrolysis, pH of salt solutions (salt of strong acid/weak base; strong base/weak acid and weak acid / weak base); indicators, indicator constant, choice of indicators in acid – base titrations.

(C) Solubility equilibria(L)

Solubility product & common ion effect; applications in group analysis –precipitation of sulphides and hydroxides.

(D) Group Chemistry – III : Group 15, 16, 17 and 18 (L)

Group 15 : Catenation, oxidation states, trends in the hydrides, halides, and oxides ; special features in the chemistry of hydrazine, hydroxylamine, hydrazoic acid/azides and phosphonitrilic compounds.

Group 16 : Catenation, atomicity, trends in the halides and hydrides; oxides and fluorides of S and Te; special features in the chemistry of the oxoacids of sulphur; Structure and bonding in O_2F_2, polythiazyl, tetrasulphurtetranitride.

Group 17 : Trends in the Chemistry of oxides, oxoacids and hydracids; special features in the chemistry of interhalogens, polyhalides, pseudohalogens, uses of potassium bromate and potassium hydrogen iodate in quantitative analysis.

Group 18 :Trends in the ionization energy and reactivities of He, Ne, Ar, Kr, Xe; reactivity, structure and bonding in fluorides and oxofluorides of Xe.

SEM – V

(A) Isomerism, Reactivity and Stability of coordination complexes (L)

Constitutional, Geometrical and optical isomerism with respect to C.N. = 4 and 6; Mills and Quibell complex, examples of purely inorganic optically active complexes; labile and inert complexes; substitution in square planar complexes and trans – effect (examples and applications); choice of ligands and stability of various oxidation states of the 3d metal ions; stability constant of complexes.

(B) Structure and Bonding in coordination complexes (L)

VBT, CFT, splitting of d^n configurations in octahedral and tetrahedral fields, crystal field stabilization energy in weak and strong fields, pairing energy, Jahn – Teller distortion and its application; MOT (elementary idea), sigma and pi – bonding in octahedral complexes (a pictorial approach)

(C) Organometallic Chemistry (L)

18 electron rule and its application to carbonyls (including carbonyl hydrides and carbonylates), nitrosyls, cyanides, metal–carbon sigma and pi – bonded organometallic complexes of transition metals; bonding and IR spectra of carbonyls and nitrosyls; Zeise's salt – its preparation properties and structure; ferrocene – its preparation, properties and sturture; elementary idea of fluxional molecules; oxidative addition, reductive elimination and insertion reactions; homogenous catalysis of organometallic compounds – hydrogenation, hydroformylation, and polymerization of alkenes (Ziegler – Natta catalyst)

SEM – VI

(A) Magnetism and Spectra of Coordination Complexes (L)

Orbital and spin magnetic moments, spin only magnetic moments of $3d^n$ ions and their correlation with effective magnetic moments, quenching of magnetic moments in presence of crystal field; ferromagnetic and anti–ferromagnetic coupling (elementary idea with examples only); d –d spectra, weak–field splitting schemes, qualitative Orgel diagrams for d^n systems and their spectroscopic ground states, selection rules for spectral transitions, charge transfer spectra (elementary idea with examples only).

(B) Bioinorganic Chemistry (L)

Essential and trace elements of life; role of metal ions in biology – Na^+, K^+, Ca^{2+}, Mg^{2+}, $Fe^{2+/3+}$, $Cu^{+/2+}$,Zn^{2+}; active site structures and bio-functions of myoglobin, haemoglobin, cytochromes, ferredoxins, carbonic anhydrase; photosynthesis – PS–I and PS–II, sodium ion pump and ionophores, metal ion induced toxicity and chelation therapy, metal ion as drugs (cisplatin and a few gold drugs)

(C) Chemistry of the Lanthanides (L)

General characteristic with respect to electronic configuration, oxidation states and ionization enthalpies, lanthanide contraction, separation of lanthanides by ion – exchange method.