NEST 2019 Syllabus

**Chemistry:**

**Physical Chemistry:**

**Measurements in chemistry** - SI units for fundamental quantities, significant figures in calculations.

**Mole concept** - Avogadro number and mole concept, molar masses, mole fraction, molarity, molality, percent composition, stoichiometry. Equivalent weight and normality. Calculations based on mole concept and stoichiometry of different reactions. Oxidation – reduction reactions.


**Thermodynamics** - Thermodynamic states. First law of thermodynamics. Internal energy, work and heat, pressure – volume work. Enthalpy and enthalpy change, Hess’s law, heat of
reaction, fusion and vaporisation. Second law of thermodynamics, entropy, free energy, criterion of spontaneity.


**Chemical kinetics** - Rates of chemical reactions. Order of reaction, rate constant. First order and pseudo first order reactions. Factors affecting rate of reaction - concentration, temperature (Arrhenius equation), catalyst.

**Solid state** - Classification of solids, amorphous and crystalline solids, crystalline state, crystal lattice and unit cells; seven crystal systems (cell parameters a, b, c, $\alpha$, $\beta$, $\gamma$), close packed structure of solids (cubic), packing in fcc, bcc and hcp lattices. Packing efficiency, nearest neighbours, ionic radii. Simple ionic compounds, Imperfection in solids, point defects. Electrical and magnetic properties, band theory of metals.

**Surface chemistry:**

(b) **Colloidal state** – Types, preparation and properties of colloids. Tyndall effect, Brownian movement, electrophoresis, coagulation. Application of colloids. Micelles.

**Inorganic Chemistry:**

**Classification of elements and periodicity in properties** - Modern periodic table, classification of elements, periodic trends in properties of elements – valence, oxidation state, atomic/ionic radius, ionization energy, electron gain energy, electronegativity, valency, chemical reactivity. Diagonal relationship. Anomalous behaviours of Li, Be, B, C.


**s – Block elements (Alkali and alkaline earth elements)** – General characteristics and trends in properties.

(a) **Group 1:** Preparation, properties and reactions of alkali metals with emphasis on chemistry of Na and K and their compounds – oxides, peroxides, hydroxides, carbonates, bicarbonates, chlorides and sulphates. Uses.

(b) **Group 2:** Preparation, properties and reactions alkaline earth metals with emphasis on the chemistry of Mg and Ca and their compounds – oxides, peroxides, hydroxides, carbonates, bicarbonates, chlorides and sulphates. Uses.

**p – Block elements** - General characteristics and trends in properties.
(a) **Group 13**: Chemistry of Boron and its compounds – borax, boric acid and diborane.

(b) **Group 14, 15 and 16**: Chemistry of carbon, sulphur, nitrogen and phosphorus. Allotropy. Chemistry of oxides and oxyacids of these elements. Phosphines, phosphorus chlorides, ammonia, peroxide and ozone; silicones, silicon tetrachloride and silicates.

(c) **Group 17**: Chemistry of halogens, chemistry of chlorine in detail. Interhalogen compounds. HX and oxyacids of halogens.

(d) **Group 18**: Isolation, properties and reactions of inert gases with emphasis on chemistry of Xenon.

**d – Block elements** - (Mainly 3d elements) General characteristics and trends in properties. Variable oxidation states and their stabilities, colour (excluding the details of electronic transitions) and calculation of spin – only magnetic moment. Catalytic properties. Interstitial compounds, alloy formation. Preparation and properties of potassium dichromate and permanganate.

**f – Block elements**- (mainly lanthanides) General characteristics and trends in properties. Variable oxidation states. Lanthanide contraction and its consequences.

**Coordination compounds** - Nomenclature of mononuclear coordination compounds. Isomerism. Hybridization and geometries of mononuclear coordination compounds. Magnetic properties. Werner’s theory, VBT, CFT.

**Organic Chemistry:**


**Reactive intermediates** - Homolytic and heterolytic bond cleavages. Formation, structure and stability of carbocation, carbanion and free radical.


**Nomenclature** - IUPAC nomenclature of simple organic compounds (only hydrocarbons, mono – functional and bi – functional compounds), including benzene derivatives.


**Alkenes and Alkynes** - Preparation, properties and reactions of alkenes and alkynes. Isomerization. Acidity of alkynes. Acid catalysed hydration of alkenes and alkynes (excluding the stereochemistry), Reactions of alkenes with KMnO4, sulphuric acid, Reduction of alkenes and alkynes, Preparation of alkenes and alkynes by elimination reactions (excluding stereochemistry), Electrophilic addition reactions of alkenes with X2, HX, HOX and H2O (X=halogen). Makownik rule. Peroxide effect. Polymerization of alkenes, Addition reactions of alkynes, Metal acetylides, Ozonolysis
Isomerism in substituted benzenes. Electrophilic substitution reaction on benzene – General mechanism. Orientating influence of substituents in electrophilic substitution reaction of monosubstituted benzenes. Electrophilic substitution reactions of benzene and substituted benzenes – halogenation, nitration, sulphonation, Friedel – Crafts alkylation and acylation (No mechanism).

Haloalkanes (Alkyl halides) - Preparation from alkanes, alcohols, ole ns. Grignard reagents and their reaction with aldehydes/ketones/esters/nitriles. Nucleophilic substitution reactions of alkyl halides with different nucleophilic species. SN1 and SN2 reactions with mechanism. Halogen exchange reaction. Polyhalogen compounds.

Haloarenes - Nucleophilic aromatic substitution in haloarenes and substituted haloarenes (excluding Benzyne mechanism and Cine substitution).


Ethers - Preparation by Williamson's Synthesis, dehydration of alcohols. Reaction with H2O, HX.

Aldehydes and Ketones – Preparation of aldehydes and ketones from – Alcohols, olefins, acid chlorides, arylalkanes, nitriles, esters, Friedel – Crafts reaction. Reactions with – Alcohols,


Peptide bond. Characteristic tests. Separation of amino acids using physical properties.
Denaturation of proteins. Enzymes.