NOTIFICATION (Advt No. 1/2018)

Syllabus (Paper III)

Post Code - 301

Area: Chemistry/Environmental Science

Atomic structure: Bohr's theory and its limitations - Dual behavior of matter and radiation - de Broglie's relation - Heisenberg Uncertainty principle - Time independent Schrodinger equation and

meaning of various terms in it - Significance of Ψ and Ψ^2 - Schrodinger equation for hydrogen - Significance of quantum numbers - Shapes of s, p and d atomic orbitals - Discovery of spin , Spin

quantum numbers and magnetic quantum number - Rules for filling electrons in various orbitals- Electronic configuration of the atoms.

Chemical bonding: General characteristics of ionic bonding - Energy configuration in ionic bonding - lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds - Dipole moment; Covalent bonding - VB approach - Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, sure planar, tetrahedral arrangements - Concept of resonance and resonating structures in various inorganic and organic compounds.

Chemical Thermodynamics: Important principles and definitions of thermodynamics - Concept of standard state and standard enthalpies of formation - integral and differential enthalpies of solution and dilution - Calculation of bond energy - Bond dissociation energy and resonance energy from thermochemical data - Variation of enthalpy of a reaction with temperature - Kirchhoff's equation.

Chemical Equilibrium: Free energy change in a chemical reaction - Thermodynamic derivation of the law of chemical equilibrium - Distinction between ΔG and ΔG^o - Le Chatelier's principle

- Relationship between K_p, K_C and K_X for reactions involving ideal gases.

Phase Equilibrium: Phases - components and degrees of freedom of a system - criteria of phases equilibrium - Gibbs Phase Rule and its thermodynamic derivation - Derivation of Clausius - Clapeyron equation and its importance in phase equilibria - Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H_2O and Na-K only).

Fundamentals of Organic Chemistry: Physical effects - Electronic displacements - Inductive effect, Electromeric effect - Resonance and hyper conjugation - Cleavage of bonds - Homolysis and heterolysis. Structure, Shape and reactivity of organic molecules - Nucleophiles and electrophiles - reactive intermediates - Carbocations, carbanions and free radicals - Strength of organic acids and bases - Comparative study with emphasis on factors effecting pK values - Aromaticity - Benzenoids and Huckel's rule.

Green Chemistry: Need and Goals of Green Chemistry - Limitations and pursuit of the goals of Green chemistry - Principle of Green chemistry - Green synthesis of adipic acid - Microwave assisted reactions in water - Ultrasound assisted reactions - Designing of environmentally safe marine antifoulant - An efficient green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn - Green chemistry in Sustainable development.

Introduction to Measurement system: Measurement, units and nomenclature - Concentration of solutions, percent composition, molarity, molality and mole fraction - conversion of units of concentration - Evaluation of analytical data, errors, accuracy and precision, normal law of distribution - statistical test of data, F, Q and t-test, rejection of data, and confidence of intervals.

Separation techniques: Solvent extraction - classification, principles and efficiency; mechanism of extraction - extraction by salvation and chelation - Techniques of extraction - batch, continuous and counter current extraction - extraction of metal ions from aqueous solutions - extraction of organic species from aqueous and non-aqueous media.

Basic principles and data interpretation of the following optical methods of analysis: UV-Visible spectrometry - Infrared spectrometry - Flame atomic absorption and emission spectrometry.

- Electroanalytical methods: Classification - basic principles of pH meter, potentiometric and conductometric titrations - techniques for determination of equivalence points and pK_a values.

- Thermal methods of analysis: Theory of thermogravimetry, basic principles of instrumentation - Techniques for quantitative estimation of Ca and Mg from their mixtures.
- Chromatography: Classification, principles and efficiency of the technique - Development of chromatograms. Qualitative and quantitative aspects of chromatographic methods of analysis IC, GLC, GPC, TLC and HPLC.

Introduction to Environmental Science - Scope and Importance of Environmental Science - Concept of Sustainable development.

Ecosystems - Structure & Functions - Energy flow - Food chains and food webs and ecological succession - Case studies of the following ecosystems: forest, lake, river and estuaries.

Natural Resources: Land resources and land change - Land degradation - soil erosion and desertification; Water - use and over-exploitation of surface and groundwater - floods, droughts, conflicts over water; Energy - renewable and non-renewable energy sources - use of alternate energy sources - growing energy needs.

Biodiversity and Conservation: Levels of biological diversity - genetic and species and ecosystem diversity; biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots; India as a mega-biodiversity nation; Endangered and endemic species of India.

Environmental Pollution: Types, causes, effects and controls - Air, water, soil and noise pollution - Solid waste management - control measures of urban and industrial wastes; Pollution case studies - River Ganda pollution issues - Bhopal toxic gas leak and tragedy

Environmental Policies and Law: Climate change - Global warming - ozone layer depletion - acid rain and impacts on human communities and agriculture. Environmental laws - Environmental (Protection) Act, 1986, Acts related to Air, Water and Wildlife Protection - Environmental standards