

द्वितीय पत्र (Paper II): Technical Subject

Section A- 20 Marks

1. Physical Chemistry

- 1.1 **Ionic Equilibrium and Electrochemistry:** Ostwald's dilution law, pH, Buffer solution, buffer capacity and buffer range, pH change in acid base titration, theory of acid base indicator, hydrolysis of salt, Debye Huckel limiting law, activity and activity coefficient, Ionic strength, Elementary idea on electrical double layer, Emf of a cell, Nernst equation, quinhydrone electrode, ion selective electrodes and their applications, photo-electrochemical and fuel cells
- 1.2 **Chemical Kinetics:** Qualitative concepts of parallel, opposing and consecutive reactions, Effect of temperature and catalyst on reaction rate, concept of activation energy, collision theory and transition state theory of reaction rates, chain reaction, photochemical reaction, laws of photochemical equivalence, quantum yield, phosphorescence, fluorescence, chemiluminescence and thermoluminescence, Fast reaction, techniques to study fast reaction, Enzyme catalyzed reaction.
- 1.3 **Thermodynamics:** First and second law of thermodynamics, Hess's law of constant heat summation, enthalpy change from bond energy, variation of heat of reaction with temperature (Kirchoff's equation), calorific value of fuel, calorific value of food. Molar heat capacities, adiabatic expansion of an ideal gas for reversible and irreversible expansion, Carnot cycle, thermodynamic efficiency, entropy and its mathematical derivation, entropy changes, irreversible process, relation between enthalpy and entropy changes, Gibbs-Helmholtz equation, free energy and work function and their significance, criteria of spontaneity.
- 1.4 **Solid state chemistry:** Seven crystal system and fourteen Bravais lattice, Bragg's law, Crystal structure of sodium chloride, Lattice energy of ionic solid, success and limitation of classical free electron theory of metal, point defects: Frenkel and Schottky defects.
- 1.5 **Surface and Colloid Chemistry:** Physical adsorption and chemical adsorption, adsorption isotherms, Freundlich isotherms, derivation of Langmuir adsorption isotherms, cleansing action of soap and detergents, emulsion and gels, solution of macromolecules, colloidal state of matter, preparation and purification of colloids, brief discussion of kinetic, optical and electrical properties of colloids.

Section B- 30 Marks

2. Inorganic chemistry

10%

- 2.1 **General concept of the followings:** Electro negativity, choice of electro negativity system, group electronegativity, electron affinity, anomalous electron affinity, ionization energy, Intrinsic and mean bond energy. Metallic bonding, Buck minister fullerene, Noble gas compounds, Non aqueous solvents, Protic and non-protic solvents, NH_3 and SO_2 as non-aqueous solvent.
- 2.2 **Molecular orbital theory:** concept of molecular orbital, LCAO approximation, MOT vs VBT
- 2.3 **Bonding and applications of coordinate compounds:** Valence bond theory, crystal field, characterization of coordinate compounds, Isomerism in coordination compounds, ligand substitution reactions and trans effect,

spectrochemical series, chelation, application of complexes in analytical and biological fields.

- 2.4 Organometallic compounds: General survey of types, synthetic methods, metallocenes
- 2.5 Radioactivity and nuclear reactions, C^{14} dating, tracer technique, radiochemical analysis

3. Analytical chemistry 20%

- 3.1 **General concept of statistical methods in chemical analysis:** Accuracy, precision, minimization of error, significant figures, mean and standard deviation, reliability of results, rejection of results, regression analysis, t-test, chi-test.
- 3.2 **Principle and applications of:** Atomic absorption spectroscopy, flame photometry, uv-vis spectrophotometry, NMR, IR, mass spectroscopy.
- 3.3 **Chromatography:** ion exchange chromatography, gas chromatography, HPLC, exclusion chromatography (gel permeation chromatography), affinity; chromatography, partition, column, paper chromatography and solvent extraction,
- 3.4 **Principle and applications of:** potentiometry, ion selective electrodes, pH measurement, polarography, and conductometry.
- 3.5 **Gravimetric and volumetric analysis:** principles of volumetric and gravimetric analysis, uses of adsorption indicators, use of Redox indicator, metal ion indicator, use of common organic reagents in gravimetric analysis.

Section C- 20 Marks

4. Organic Chemistry

- 4.1 **General idea on mechanism and scope of the following types of reactions:** Nucleophilic reaction, Elimination reaction, Addition reaction and Free radical reaction
- 4.2 **Study and application of the following types of organic reactions:** Oxidation and reduction, Halogenations, Acetylation, Alkylation, Acylation and condensation.
- 4.3 **Organic photochemistry:** basic concepts on photochemistry of carbonyl compounds, photochemical aromatic substitution, photo- isomerization and photoreduction.
- 4.4 **Structure and reactivity of the following heterocyclic compounds:** Thiazole, Furan and Pyridine
- 4.5 **Stereochemistry:** Symmetry and symmetry elements, Enantiomers, Diastereomers, Meso-isomers, Racemic mixture, Enantio-selective reaction, Diastereo-selective reaction, Regio-selective reaction.

Section D- 30 Marks

5. Conservation technologies

- 5.1 **Terminologies:** Conservation, restoration, preservation, renovation, preventive conservation, consolidation, water repellents, reproduction.
- 5.2 **Introduction to Archaeological objects:** Classification, nature of deterioration, co-operative approach to conservation.
- 5.3 **Introduction to Archival materials:** Nature, causes of deterioration, preventive care, repair and restoration, recovery of faded ink.

- 5.4 **Agents of deterioration of Museum objects:** Direct physical forces, thieves, vandals' displacers, fire, water, pests, contaminants, radiation, temperature, relative humidity, pollution and flood
- 5.5 **Stone conservation:** Classification of stones, types of deterioration, causes of deterioration, photographic documentation, clearing methods and conservation treatments
- 5.6 **Pigments:** Red, green, blue, yellow, black, gold and silver, white.
- 5.7 **Metal conservation:** Corrosion, classification of metals on the basis of corrosion behaviour, deterioration of metal objects, cleaning, consolidation and preventive measures.
- 5.8 **Ceramics:** Different types of ceramics, causes of deterioration, salt removal (soluble and insoluble), stain removal, repair and cleaning
- 5.9 **Wooden artifacts:** Physical, chemical and biological causes of deterioration and control measures.
- 5.10 **Uses of traditional techniques for conservation:** Techniques involving uses of Neem, Camphor, Turmeric and Sandalwood
- 5.11 **Termite controls in the museums and the historic buildings:** classification, detection and prevention
- 5.12 **Eradication of plants in the monuments:** Physical and chemical methods.

प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र
लिइने **सामूहिक परीक्षण (Group Test)** को लागि

सामूहिक छलफल (Group Discussion)

यस प्रयोजनको लागि गरिने परीक्षण १० पूर्णाङ्क र ३० मिनेट अवधिको हुनेछ जुन नेताविहिन सामूहिक छलफल (Leaderless Group Discussion) को रूपमा अवलम्बन गरिने छ। दिइएको प्रश्न वा Topic का विषयमा पालैपालोसँग निर्दिष्ट समयभित्र समूहबीच छलफल गर्दै प्रत्येक उम्मेदवारले व्यक्तिगत प्रस्तुति (Individual Presentation) गर्नु पर्नेछ। यस परीक्षणमा मूल्याङ्कनको लागि देहाय अनुसारको ३ जना भन्दा बढीको समिति रहनेछ।

आयोगका सदस्य	-	अध्यक्ष
आयोगका सदस्य	-	सदस्य
मनोविज्ञ	-	सदस्य
दक्ष/विज्ञ (१ जना)	-	सदस्य

सामूहिक छलफलमा दिइने नमूना प्रश्न वा Topic

उदाहरणको लागि - उर्जा संकट, गरीबी निवारण, स्वास्थ्य बीमा, खाद्य सुरक्षा, प्रतिभा पलायन जस्ता Topics मध्ये कुनै एक Topic मात्र दिइनेछ।