

द्वितीय पत्र (Paper II) : Technical Subject

Section A- 20 % Marks

1. Physical Chemistry

- 1.1 Ionic Equilibrium and Electrochemistry: 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, glass electrode, ion selective electrode and their applications, photo electrochemical and fuel cells
- 1.2 Chemical Kinetics: 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, Fast reaction, techniques to study fast reaction, Enzyme catalyzed reaction, Diffusion controlled reaction in solution kinetic salt effect
- 1.3 Thermodynamics: Statistical treatment of entropy, Entropy change in physical and chemical change, free energy change for reaction, Gibbs Helmholtz equation, Thermodynamic criteria of equilibrium, chemical potential, partial molar quantities, Boltzman distribution law
- 1.4 Spectroscopy and Solid state chemistry: Electromagnetic radiation, origin of molecular spectra, types of molecular spectra: Rotational spectra, vibrational spectra, vibrational rotational spectra, Electronic spectra. 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

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, Reactions of  $\text{NH}_3$  and  $\text{SO}_2$
- 2.2 Molecular orbital theory, molecular orbital, LCAO approximation, valence bond theory for simple homonuclear diatomic
- 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, Nephelausetic effect, Jahn Teller effect, Evidence for adjusted crystal field theory
- 2.4 Organometallic compounds: General survey of types, synthetic methods, metallocenes
- 2.5 Radioactivity and nuclear reactions,  $^{14}\text{C}$  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.

## लोक सेवा आयोग

नेपाल इन्जिनियरिङ्ग सेवा, केमिष्ट्री समूह, राजपत्रांकित तृतीय श्रेणीका पदको खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

- 3.2 Principle and applications of: Atomic absorption spectroscopy, flame photometry, uv-vis spectrophotometry, NMR, IR, mass spectroscopy, emission spectroscopy.
- 3.3 Solvent extraction, ion exchange chromatography, gas chromatography, HPLC, exclusion chromatography (gel permeation chromatography), affinity; chromatography, partition, column, and paper chromatography, thermo gravimetric analysis, differential thermal analysis,
- 3.4 Principle and applications of potentiometry, ion selective electrodes, pH measurement, polarography, amperometry, electrogravimetry 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 reagent s in gravimetric analysis.

### Section C- 20 %Marks

#### 4. Organic Chemistry

- 4.1 General idea on types, mechanism and scope of the followings:
  - 4.1.1 Nucleophilic reaction
  - 4.1.2 Elimination reaction
  - 4.1.3 Addition reaction
  - 4.1.4 Free radical reaction
- 4.2 Study and application of the followings:
  - 4.2.1 Oxidation and reduction reactions
  - 4.2.2 Halogenations
  - 4.2.3 Acetylation
  - 4.2.4 Alkylation
  - 4.2.5 Acylation
  - 4.2.6 Aldol condensation and related reactions.
- 4.3 Photochemistry:
  - 4.3.1 Basic concept of Photochemical energy
  - 4.3.2 Electronic excitation
  - 4.3.3 Energy transfer
  - 4.3.4 Photochemistry of carbonyl compounds
- 4.4 Heterocyclic Chemistry: Structure and reactivity of the following heterocyclic compounds:-
  - 4.4.1 Pyrrole
  - 4.4.2 Thiazole
  - 4.4.3 Furan
  - 4.4.4 Imidazole
  - 4.4.5 Pyridine
  - 4.4.6 Indole
- 4.5 Stereochemistry:
  - 4.5.1 Symmetry and symmetry elements
  - 4.5.2 Enantiomers
  - 4.5.3 Diastereomers
  - 4.5.4 Meso-isomers
  - 4.5.5 Racemic mixture
  - 4.5.6 Enantioselective reaction
  - 4.5.7 Diastereoselective reaction
  - 4.5.8 Regioselective reaction
- 4.6 Carbohydrate: Chemistry of Glucose, fructose, sucrose and cellulose

**Section D- 30 % Marks**

**5. Biochemistry and applied chemistry**

**5.1 Biochemistry**

**10%**

5.1.1 Natural products and drug analysis:

- 5.1.1.1 Phytochemical screening
- 5.1.1.2 Isolation, purification and identification of natural molecules (essential oil, alkaloids, terpenoids, flavonoids)
- 5.1.1.3 Biosynthesis of lipids and terpenes with taking typical examples of stearic acid and citral
- 5.1.1.4 Vitamins and hormone
- 5.1.1.5 Chemotherapy
- 5.1.1.6 Drugs
- 5.1.1.7 Synthetic drugs: types and typical examples
- 5.1.1.8 Identification, qualitative and quantitative analysis of various antibiotics
- 5.1.1.9 Quantitative analysis of dextrose, ascorbic acid, vitamin A in various products

5.1.2 Lipids:

- 5.1.2.1 Composition of fats
- 5.1.2.2 Hydrolyses
- 5.1.2.3 Phosphoglycerides
- 5.1.2.4 Rancidity types
- 5.2.1.5 Prevention

5.1.3 Enzymes, Proteins and Nucleic Acids:

- 5.1.3.1 Enzymes and co-enzymes, Co-factors
- 5.1.3.2 Application of enzymes in food industries
- 5.1.3.3 Structure and reactions of amino acids, peptides
- 5.1.3.4 Protein
- 5.1.3.5 Nucleic acids, Biological functions of DNA and RNA
- 5.1.3.6 Regulation of gene expressions and Genetic code

**5.2 Applied chemistry**

**20%**

5.2.1 Soil, sediments and rock analysis:

- 5.2.1.1 Soil texture and organic matter in soil
- 5.2.1.2 Cu, Pb, Zn & Ag in soil, sediments and rock
- 5.2.1.3 Acid insoluble matter, loss on ignition, CaO, MgO, total oxide ((Fe<sub>2</sub>O<sub>3</sub>, Al<sub>2</sub>O<sub>3</sub>) and SiO<sub>2</sub> in limestone, dolomite and magnesite.

5.2.2 Water, wastewater and air analysis:

- 5.2.2.1 BOD, COD, dissolved oxygen, alkalinity, ammonia, nitrite, nitrate, chloride, phosphate, sulfate, iron, manganese, arsenic and other toxic metals in water and wastewater.
- 5.2.2.2 PM<sub>10</sub>, TSS, SO<sub>2</sub>, CO, CO<sub>2</sub>, NO<sub>x</sub> in air

5.2.3 Food, food products and feed analysis:

- 5.2.3.1 Proximate analysis (moisture, protein, fat and carbohydrate) of food, food products and feed
- 5.2.3.2 Color detection in food and food products.
- 5.2.3.3 Simple chemical methods (quick test) for detection of food adulteration.
- 5.2.3.4 General concept of Pesticide and pesticide residue analysis in water, soil and foodstuff.

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पाठ्यक्रम

5.2.4 Analysis of industrial products:

5.2.4.1 Urea

5.2.4.2 Fertilizer

5.2.4.3 Bleaching powder

5.2.4.4 Alcohol

5.2.5 Miscellaneous:

5.2.5.1 Application of chemical methods in preservation of archaeological property.

5.2.5.2 Application of good laboratory practice and ISO 17025 concepts in the quality management.

5.2.5.3 Role of Chemists in Environmental Impact Assessment

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पाठ्यक्रम

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 नमुना प्रश्न वा Topic**

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