Second Semester **Total: 100 Marks**

Chem EH 201

PART A ***Inorganic, Organic & Physical Theory*** **75 marks** (19-56)

Section 1 (*Inorganic*) *19 marks*

Unit I *9½ marks*

(a) Principles of Qualitative and Quantitative Analysis: Solubility product and its applications in the Group separations of cations, Volumetric analysis – standard solutions, primary standards, expressing concentrations of standard solutions, redox titrations (potassium permanganate, potassium dichromate, sodium thiosulphate and iodine), iodometric and iodimetric titrations, acid-base indicators and its theory.

(b) Acid-Base Concept: Arrehenius and Bronsted-Lowry concept, the solvent-system (Franklin) concept and its limitations; Lewis concept; effect of solvent on relative strengths of acids and bases – leveling effect; Relative strengths of acids and bases (pK_a and pH concept).

Unit II *9½ marks*

(a) Redox Reactions: Electronic concepts of oxidation and reduction, oxidation number, common oxidants and reductants, balancing of redox reactions by ion electron method, calculation of equivalent weights of oxidants and reductants, standard electrode potential, electrochemical series and its application.

(b) Some Concepts of Metallurgy: Minerals and ores, principles and methods of extraction – concentration, oxidation, reduction, electrolytic method and refining, occurrence and principles of extraction of aluminium, copper and iron.

(c) Industrial Chemistry

(i) Fertilizers – Nitrogen fertilizer, manufacture of ammonia, and urea. Phosphatic fertilizers – calcium superphosphate, and NPK fertilizers.

(ii) Cement – constituents, manufacture and setting process, role of gypsum.

(iii) Paints and Pigments: constituents of paints; classification of pigments on the basis of their colour with examples.

Section 2 (*Organic*) 19 Marks

Unit III 9½ marks

***(a) Nucleophilic Substitution Reactions*:** Nucleophile, ambident nucleophile, SN^1, SN^2, SN^i, factors affecting substitution reactions (structure of substrate, nature of nucleophile, solvent, role of leaving group), mechanism and stereochemistry of substitution reactions difference between nucleophile and bases.

(b) Elimination reactions: E^1, E^2, E^1cB mechanisms, orientation in elimination reactions (Saytzeff's and Hoffmann's rules).

***(c) Alkyl Halides*:** Preparation and reactions (hydrogenolysis, aqueous and alcoholic KOH, NH_3, carbon nucleophiles, sulphur nucleophiles, KCN, AgCN, KNO_2, $AgNO_2$, RCOOAg, RONa, Mg, Li, Na).

***(d) Aromatic Halogen Compounds*:** Introduction, preparation and chemical reactivity, nuclear and side chain halogenation, electrophilic and nucleophilic substitution in aromatic halogen compounds. Role of ring substituents in nucleophilic substitutions.

Unit IV 9½ marks

***(a) Alcohols*:** Classification and nomenclature, method of preparation including hydration, hydroboration-oxidation and oxymercuration-reduction, industrial prepration of ethyl alcohol (from molasses and starch), reaction of alcohols, distinction between primary, secondary and tertiary alcohols (Victor Meyer's test, Lucas test), preparation and chemical reactions of glycol (HNO_3, HCl, PX_3, terephthalic acid, Oxidation) and glycerol. (HNO_3, HI, oxalic acid, $KHSO_4$)

***(b) Phenols*:** Nomenclature, structure and bonding. Preparation, industrial preparation from Cumene, physical properties and acidic character, chemical reactions, nitration, halogenation, sulphonation, Kolbe's reaction, Reimer-Tiemann reaction, phenol-formaldehyde resin.

***(c) Aldehydes and Ketones*:** Nomenclature and structure of the carbonyl group, method of preparation of aldehydes and ketones (both aliphatic and aromatic), chemical reactivity of carbonyl group, mechanism of nucleophilic additions and addition-elimination reactions with HCN, $NaHSO_3$, NH_2OH, NH_2-NH_2, $C_6H_5NHNH_2$, $NH_2CONHNH_2$) and Cannizzaro reaction; acidity of α-hydrogen in carbonyl compounds and formation of enolates, aldol condensation, Perkin reaction and reactions with Grignard reagents, benzoin condensation, reduction and oxidation reactions (Clemmensen and Wolff-Kishner reductions).

Section 3 (*Physical*) *18 Marks*

Unit V *9 marks*

(a) Thermodynamics-I: Definition of thermodynamic terms- system and surrounding, types of systems, intensive and extensive variables, types of processes- isothermal, adiabatic, isobaric, reversible, irreversible and cyclic processes; Thermodynamic functions- state variables and exact differentials, concept of heat and work, path functions and inexact differentials, zeroth law of thermodynamics, work done during reversible volume change of ideal gas.

First law of thermodynamics: Statement, internal energy, enthalpy, heat capacity at constant pressure (C_p) and volume (C_v), relation between C_p and C_v. Limitations of first law, spontaneous processes, statements of second law. Joule-Thomson coefficient and inversion temperature.

(b) Macromolecules: Characteristics of macromolecules; degree of polymerization; concepts of number and weight average molecular mass; determination of molecular mass by osmometry and viscometry.

Unit VI *9 marks*

(a) Thermochemistry: Exothermic and endothermic reactions, Hess's law of constant heat summation, enthalpy of formation, standard state, enthalpy of combustion, enthalpy of neutralization, enthalpy of solution, enthalpy of dilution, Kirchoff's equations- influence of temperature on ΔH and ΔU of a reaction

(b) Adsorption and Surface Phenomena: Physisorption and chemisorption, adsorption isotherms, derivation and application of Langmuir adsorption isotherm, Freundlich adsorption isotherm.

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PART B *Practical* (Physical) 25 Marks (17:18)

Laboratory Course (Physical)

The following experiments are to be carried out in the class. In the examination, each student should be asked to do any **one** experiment from this list given below.

List of Experiments

(1) Determination of the heat of neutralization of a strong acid by a strong base.

(2) Determination of molecular weight by Rast's method

(3) Study of the heat of dilution of H_2SO_4 and then to determine the strength of an umknown acid.

(4) Determination of the velocity constant of the decomposition of hydrogen peroxide in presence of ferric chloride as catalyst by titrating against $KMnO_4$.

(5) Determination of the solubility of $BaCl_2$/NaCl at two different temperatures and to determine the heat of solution.

(6) Determination of the velocity constant of the hydrolysis of methyl acetate catalysed by an acid.

Assignment of Marks

Viva Voce	: 05 Marks
Laboratory Record	: 03 Marks
Experiment	: 10 Marks