Third Semester **Total: 100 Marks**

Chem EH 301

PART A *Inorganic, Organic & Physical Theory* 75 marks (19.56)

Section 1 (*Inorganic*) *18 marks*

Unit I: s- and p-Block Elements and Their Compounds *6 marks*

Group discussion of the elements with respect to position in the periodic table, electronic configuration, atomic and ionic radii, ionization enthalpy, electron gain enthalpy, electronegativity, oxidation states, variation of acidic and basic properties of their oxides and oxy-acids, inert pair effect and catenation.

Preparation, important reactions, structure and use of the following compounds: sodium thiosulphate. potassium iodide, boric acid, aluminium chloride, lithium aluminium hydride, hydrazine, and lead tetraacetate.

Unit II: d- and f-Block Elements *6 marks*

Electronic configuration of d-block elements, Transition metals-defination andcharacterstic features of transition metals, relative stability of oxidation states, variation of properties in first, second and third row transition metals.

Electronic configurations of lanthanides and actinides, comparison of their oxidations states, synthetic elements, variation in their atomic and ionic radii – lanthanide contraction ,difficulty in the separation of lanthanides – and ion exchange method of separation.

Preparation, important reactions, structures and uses of nickel tetracarbonyl, potassium ferrocyanide, potassium ferricyanide. potassium dichromate. potassium permanganate, and uranium hexafluoride.

Unit III: Coordination Compounds *6 marks*

Werner's Coordination theory, coordination number. ligands and their classification, chelation, applications of chelate formation; nomenclature of coordination compounds, effective atomic number rule, isomerism in coordination compounds, geometrical and optical isomerism in 4- and 6-coordinate complexes; Sidgwick's effective atomic number rule; stereochemistry of complexes

with coordination numbers 4 and 6, bonding in transition metal complexes: valence bond theory and elementary idea of crystal field theory for octahedral and tetrahedral complexes.

Section 2 (*Organic*) *19 marks*

Unit IV *9½ marks*

(a) Carboxylic Acids and their Derivatives: Nomenclature, structure and bonding, effect of substituents on the acidity of carboxylic groups, methods of preparation, chemical reactivity, reactions of oxalic acid, succinic acid and citric acid. Preparation and properties of acid chlorides, amides, esters and anhydrides.

(b) Organometallic Compounds-I: Grignard reagents: Synthesis of alkanes, alcohols, acids, aldehydes, ketones, amines with mechanism. Organolithium compounds: preparation and reactions with H_2O, CO_2 & epoxide.

(c) Active Methylene Compounds: Active methylene group, examples of active methylene compounds, tautomerism, difference between tautomerism and resonance (keto-enol tautomerism). Synthetic use of ethyl acetoacetate and diethyl malonate.

Unit V *9½ marks*

(a) Nitro Compounds (Aliphatic and Aromatic): Preparation, properties (aliphatic)—α–hydrogen acidity, halogenation, reaction with NaOH, HNO_2, hydrolysis, carbonyl compounds. Reduction of aromatic nitro compounds (aliphatic and aromatic)

(b) Amines (Aliphatic and Aromatic): Nomenclature and structure of amines, preparation of amines, basicity and effect of substituents on basicity, chemical reactivity- acylation, action of nitrous acid, action of CS_2, carbyl amine reaction, condensation with carbonyl groups and ring substitution. Distinction between primary, secondary and tertiary amines and their separation.

(c) Diazo Compounds: Preparation and stability of diazo compounds (aliphatic and aromatic). Reactions of benzene diazonium chloride. Preparation and reactions of diazomethane.

Section 3 (*Physical*) *19 marks*

Unit VI *9½ marks*

(a) Thermodynamics-II: Carnot cycle and its efficiency. Carnot's theorem. Entropy (S) as a state function, entropy changes of ideal gases in different processes. Gibbs function (G) and Helmholtz function (A), criteria for thermodynamic equilibrium and spontaneity, variation ΔG

and ΔA with pressure, volume and temperature, Gibbs-Helmholtz equation, Clausius-Clapeyron equation, Trouton's rule.

(b) Chemical Equilibrium: Law of mass action, equilibrium constant (K) from thermo-dynamic considerations, temperature and pressure dependence of equilibrium constants (K_p and K_c) – van't Hoff equation, relation of K_p and K_c, equilibria in homogeneous and heterogeneous systems, Le Chatelier's principle.

Unit VII *9 ½ marks*

***(a) Chemical Kinetics-I*:** Rate of reaction and rate constant, molecularity and order of a reaction, zero order reaction, differential and integrated forms of rate equations of first and second order reactions, pseudo-unimolecular reactions, determination of order of reactions, effect of temperature on reaction rates and energy of activation, effect of catalyst.

***(b) Dilute Solutions*:** Colligative properties, Raoult's law and Henry's law, relative lowering of vapour pressure, elevation in boiling point, depression in freezing point, osmosis, osmotic pressure and its determination, relation between colligative properties and molecular mass, determination of molecular mass, van't Hoff factor, abnormal molar mass, Reverse osmosis and its applications.

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PART B Practical *(Inorganic-I)* **25 marks** (7:18)

Laboratory Course (Inorganic)

Total Practical Examination Time: 6 hours

Part I: Qualitative Analysis *10 marks*

Inorganic Mixtures containing five radicals/ions to be analyzed – one of the radicals /ions must be interfering (borate, chromate or phosphate). Following ions/radicals to be included:

Ag^{+}, Pb^{2+}, Hg_2^{2+}, Hg^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, As^{3+}, Sb^{3+}, Sn^{2+}, Sn^{4+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Ba^{2+}, Cr^{3+}, Zn^{2+}, Mn2+, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+}, K^{+}, NH_4^{+}.

Cl^{-}, Br^{-}, I^{-}, SO_4^{2-}, NO_3^{-}, BO_3^{3-}, PO_4^{3-}, CrO_4^{2-}.

Part II:

(a) Sessional Work : 3 marks

(b) Viva Voce : 5 marks