Fourth Semester **Total: 100 Marks**

Chem EH 401

PART A ***Inorganic, Organic & Physical Theory*** 75 Marks (19:56)

Section 1 (*Inorganic*) *18 marks*

Unit I *10 marks*

(a) Organometallic Chemistry-I: Definition and classification; synthesis, properties, nature of bonds, structure and application of one organometallic compound each of lithium, magnesium, and iron.

(b) Inorganic Polymers: General properties of Inorganic polymers and distinction from the organic polymers; synthesis, structural aspects and uses of silicones, phosphonitrilic halides, phosphazenes, and tetrasulphurtetranitride.

(c) Interhalogens, Polyhalides and Pseudohalides – types of interhalogens and their reactivity, polyhalides of iodine, definition of pseudohalides – study of CN^-, SCN^-, structure of ClF_3, BrF_3, BrF_5 and IF_7.

Unit II *08 marks*

***(a) Earth's Atmosphere*:** Acid rain, smog, ozone layer (formation, decomposition, ozone hole).

***(b) Waste-water treatment*:** General criteria and guidelines; primary treatment, secondary treatment (activated sludge process and use of coagulants), and tertiary treatments processes (disinfection, sand bed filtration, electrodialysis, reverse osmosis).

***(c) Solid waste disposal*:** Composting; anaerobic digestion of biological wastes; incineration and landfills; e-pollution.

***(d) Radioactive waste*:** Types, sources and methods of disposal.

Section 2 (*Organic*) *19 marks*

Unit III *9½ marks*

***(a) Carbohydrates-I*:** Classification and nomenclature, interrelationship among monosachharides. Reaction of glucose and fructose with Br_2, HCN, Tollen's reagent, Fehling's solution, hydroxylamine, phenylhydrazine, HNO_3 and osazone formation. Elucidation of pyranose and furanose structures. Determination of ring size. Haworth projection formula, configuration of

glucose and fructose. Epimerization, inter-conversion of aldoses and ketoses. Ascending and descending series.

(b) Amino Acids: Classification, synthesis of α-haloacids and Gabriel syntheses of glycine, alanine, phenyl alanine; glutamic and aspartic acids. Physical properties, isoelectric points and zwitterionic structure. Elementary ideas of proteins and peptides.

(c) Urea: Preparation of urea, reactions of urea with HNO_3, H_2O, HNO_2, NaOBr, CH_3COCl, C_2H_5OH, NH_2NH_2 and diethyl malonate, formation of biuret.

(d) Drugs: Classification of drugs as antipyretic, analgesic, antibacterial, antiviral, antibiotic, sulpha drugs and tranquilizer with one example each. Synthesis and use of aspirin, paracetamol, sulphaguanidine, barbituric acid.

Unit IV *9½ marks*

(a) Heterocyclic Compounds-I: Introduction; molecular orbital picture, aromatic charact-eristics and resonance, preparation and electrophilic substitution reactions of pyrrole, furan and thiophene. Structure, synthesis and reactions of pyridine, comparative basicity of pyrrole/ pyridine, pyrrole/ pyrrolidine and pyridine/ piperidine.

(b) Fats, Oils, Soaps and Detergents: Animal and vegetable oils, drying and non-drying oils, hydrogenation, iodine value, RM value and saponification value, soaps and detergents, mechanism of cleansing action of soap and detergents.

(c) Dyes: Relationship between colour and constitution, chromophore and auxochrome, classification of dyes (based on structure and application), syntheses of methyl orange, Bismarck brown, Malachite green and phenolphthalein.

Section 3 (*Physical*) *19 marks*

Unit V *9½ marks*

(a) Ionic Equilibrium: Ostwald's dilution law and its uses, dissociation equilibria of weak electrolytes, dissociation constant of weak acids (K_a), ionic product of water (K_w), hydrogen ion concentration and pH scale, buffer solutions and buffer activity, hydrolysis constant (K_b), relation between K_a, K_w and K_b, derivation of hydrolysis constant for salts of (i) strong acid and weak base, (ii) weak acid and strong base and (iii) weak acid and weak base, solubility product, common ion effect.

(b) Electrochemistry-I: Electrical transport –conduction in metals and in electrolyte solutions, specific conductance, equivalent and molar conductances and their determination, variation of equivalent and specific conductance with concentration of strong and weak electrolytes. Migration of ions and Kohlrausch law, transport numbers and their determination using Hittorf's and moving boundary methods. Arrhenius theory of electrolyte dissociation.

Unit VI *9½ marks*

(a) Electrochemistry-II: Electrochemical cells. Half cells: types and examples; types of reversible electrodes; Electrode reactions; Nernst equation and standard electrode potentials; different types of electrodes, reference electrodes; sign conventions; electrochemical series.

(b) Phase Equilibria: Phase rule and meaning of the terms phase, components and degrees of freedom, equilibrium between phases, phase diagram for one component systems (water and sulphur systems), Typical phase diagrams of two component systems involving eutectic (KI-H_2O), congruent (phenol-aniline) and incongruent (NaCl-H_2O) melting points.

Liquid-liquid mixtures, fractional distillation of binary miscible liquids, azeotropes (ethanol-water system), partial miscibility of liquids, lower and upper critical solution temperatures (triethylamine-water, phenol-water and nicotine-water systems). steam distillation, Nernst distribution law – derivation and its application.

Chem EH 401

PART B *Practical (Inorganic-II)* **25 Marks** (7:18)

Laboratory Course (Inorganic)

Total Practical Examination Time: **6** hours

Section 1: Quantitative Analysis ***10 marks***

Volumetric Estimation: Redox titration involving potassium permanganate, and potassium dichromate for the estimation of Fe^{2+}, Fe^{3+} and Ca^{2+} and iodometric estimation of Cu^{2+}.

Section 2:

(a) Sessional Work: 3 marks

(b) Viva Voce: 5 marks