KUT 203/2 - Chemistry Practical III – Inorganic

Course Objective : To become acquainted with the common techniques on the synthesis of inorganic compounds and methods of characterization

Experiment title	**Content**	**Number of laboratory hours**	**Expected outcome – upon completion of these experiments, the student should be able to:**
1. Study of A Metal Complex, Potassium Trioxalatoaluminium (III) Trihydrate, $K_3[Al(ox)_3].3H_2O$	• Preparation of $K_3[Al(ox)_3].3H_2O$ • Analysis of $K_3[Al(ox)_3].3H_2O$	3	• Understand the definition and technique on the synthesis of the metal complex i.e. $K_3[Al(ox)_3].3H_2O$. • Determine the composition of metal complexes in both acid and basic mediums.
2. Preparation and Conductivity of $[Co(NH_3)_4CO_3]NO_3$ and $[Co(NH_3)_5Cl]Cl_2$	• Preparation of $[Co(NH_3)_4CO_3]NO_3$ and $[Co(NH_3)_5Cl]Cl_2$ • Determination of molar conductivity of the complexes	4	• Understand the common technique on synthesis and the chemical properties of two coordination compounds i.e. $[Co(NH_3)_4CO_3]NO_3$ and $[Co(NH_3)_5Cl]Cl_2$. • Substantiate the difference between these ionic complexes by using the conductivity measurement which indicates the presence of free ions.
3. Synthesis of Bis(triphenylphosphine) Copper(II) Borohydride, $(Ph_3P)CuBH_4$	• Synthesis of $(Ph_3P)CuBH_4$ • Spectroscopic and physical analysis of the complex	3	• Understand the definition of electron deficient compounds within the context of coordination complexes. • Characterize the compound from qualitative viewpoints by using the spectroscopic technique such as IR and ^{1}H-NMR.

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4. Complex Ion Composition Using Job's Method	• Preparation of Ni(II) complex solution with different mole fraction of ligand (ethylenediamine) • Determination of mole ratio of Ni:ligand by UV-Vis spectroscopic technique	2	• Synthesize and isolate the complex containing free ions in the solution. • Apply continuous variation method or Job's method in investigating the composition of complex ions.
5. The Chemistry of Vanadium	• Preparation of standard solution of vanadium(V) complex • Reduction of vanadium(V) by zinc (without air), zinc and sulfur dioxide • Identification of ionic vanadium species through the presence of various colors in solution	3	• Understand the chemical properties of the first row d-block metal i.e. vanadium. • Understand the correlation between the colors of transition metal or metal ion with its oxidation state i.e. VO_2^+ (yellow), VO^{2+} (blue) etc. • Determine the composition of a metal complex of which the metal exists in various oxidation states by using the titration technique.
6. Electronic Spectra of Coordination Compounds	• Preparation of coordination compounds: potassium tris(oxalate)chromate(III) trihydrate and potassium hexathiocyanato chromate(III) tetrahydrate • Study on the electronic properties of Cr(III) complexes by UV-Vis spectroscopic technique • Investigation of the ligand field splitting energy in each complex via the determination of Δ_{oct}	4	• Synthesize several coordination compounds which possess different ligands either within or outside the coordination sphere i.e.$K_3[Cr(C_2O_4)_3].3H_2O$ and $K_3[Cr(SCN)_6].4H_2O$. • Understand the field strength among different ligands such as C_2O_4, H_2O, SCN etc. • Understand the concept on electronic transition among these complexes which can be inferred from the UV-Vis spectra. • Calculate the ligand field splitting energy (Δ_{oct}) which serve to substantiate the field strength among these ligands.

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7. Preparation and Reaction of Tris(ethylenediamine)cobalt (III) into Its Optical Antipode	• Preparation of barium d-tartrate • Molecular rotation determination for the two diastereomers • Determination of percent composition of iodide in complex	11	• Understand the concept on optical isomerism in coordination compounds and the synthesis of these isomers or isolation of D- and L-isomers. • Determine the composition of isomers thus isolated through titration. • Substantiate the optical behaviour of these isomers.
8. Characterisation of the Linkage Isomers: Nitropentaamminecobalt(III) Chloride, $[Co(NH_3)_5NO_2]Cl_2$, and Nitritopentaamminecobalt(III) Chloride, $[Co(NH_3)_5ONO]Cl_2$	• Preparation of $[Co(NH_3)_5Cl]Cl_2$ • Preparation of the X isomer • Preparation of the Y isomer • Determination of the infrared spectrum	5	• Understand the concept on lingkage isomerism in coordination compounds and the technique used in the synthesis and isolation of these complex ions i.e. $[(NH_3)_5CoNO_2]Cl_2$ and $[(NH_3)_5CoONO]Cl_2$. • Substantiate the functional group present in the isomers using the spectroscopic technique such as IR.
9. The Electronic Spectra of Some Copper(II) complexes	• Preparation of $[Cu(NH_3)_4]SO_4.H_2O$ • Preparation of $K_2[Cu(ox)_2].2H_2O$ • Preparation of $[N(CH_3)_4]_2[CuCl_4]$ • Study on the electronic properties of Cu(II) complexes by UV-Vis spectroscopic technique • Study on the spectrochemical series based on ligand field splitting energy Δ_{oct}	6	• Understand the absorption of UV-Vis radiation by the transition metal complexes which results in the electronic transition among d orbitals of the central metal. • Understand the connectivity between the types of ligands and its Δ values which corresponds to the d-orbital splitting for these complexes. • Understand the concept on how to derive the spectrochemical series for some common ligands.
TOTAL		**41**	