BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: M.Sc **SEMESTER : II**
BRANCH: CHEMISTRY **SESSION : SP/2025**

SUBJECT: CH408 ADVANCED INORGANIC CHEMISTRY

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	For a multi electronic system, graphically represent the mutual inclination of electron orbit and resultant vectors.	[3]	1	1
Q.1(b)	Explain why for both $[Co(CH_3)_4]Cl_2$ and $K_3[CoF_6]$, $\mu_{eff} > \mu_{spin\ only}$.	[2]	1	2
Q.1(c)	Derive the expression of magnetic moment for systems with band width larger than thermal energy.	[5]	1	2
Q.2(a)	Compare the magnetic moment of the following: $[(NH_3)_5Cr\text{-}O\text{-}Cr(NH_3)_5]Br_4$ and $[(NH_3)_5Cr\text{-}OHCr(NH_3)_5]Br_5$.	[5]	2	2
Q.2(b)	For the molecules of formula: $[Cu(RCOO)_2H_2O]_2$, discuss the trend in magnetic moment for R = CH_3, *t*-Bu, Cl_2CH, CF_3 and establish the mechanistic pathway for the antiferromagnetic coupling	[5]	2	3
Q.3(a)	Discuss spin admixture in $[Fe(III)TPP]^+$, where TPP is Tetra phenyl porphyrine.	[4]	3	2
Q.3(b)	Calculate the % of low spin Fe(III) in tris-dimethyl dithio carbamato Fe(III) ion from the following data: μ_{eff} = 4.3 at room temperature.	[4]	3	2
Q.3(c)	For a multi electronic system, graphically represent the mutual inclination of electron orbit and resultant vectors.	[2]	3	1
Q.4(a)	(i) What are the STYX numbers in Lipscomb's model? Calculate the possible STYX code for the B_5H_9 boron Cluster. (ii) How do Wade's rules correlate the number of framework electrons with the structure of the Boron cluster (as closo, nido, archno or hypo)? predict the $C_2B_4H_6$ and B_5H_9 cluster compound structure based on Wade's rule.	[2+3]	4	1
Q.4(b)	Based on molecular orbital theory (MOT), discuss the formation of a Di-nuclear cluster compound. Using MOT, predict the bond order in the binuclear cluster of i) $[Re(CH_3)_4]^{2-}$ and ii) $[Cr(CO)_2(\eta^5 - Cp)]_2$; cp=cyclopentadienyl anion.	[3+2]	4	2
Q.5(a)	Predict the total valence electron count (TVE) and the total number of atoms (n) upon condensation of polyhedral units (according to Mingo's rule) of i) *Two* Tetrahedral units via face-sharing; and ii) *One Tetrahedral* unit and *one closed* triangle via edge-sharing. Also, draw the structure of the initial and final polyhedra for both (i) and (ii).	[5]	5	2
Q.5(b)	(i) Write the reactions for the following transformation and identify the structure of reactants and product/(s) for (a) Hydrolysis of *cyclic-tetra*-phosphonitrilic chloride; and (b) Ammonolysis of S_2Cl_2 (ii) Explain the structure of (a) $[Os_{10}(CO)_{22}C]^{2-}$ and (b) $[Rh_7(CO)_{16}]^{3-}$ based on the capping rule.	[2+3]	5	2

::::::26/04/2025::::::E