B.Sc. 5th Semester (Honours) Examination, 2023 (CBCS)
Subject : Chemistry
Course : CC-XI
(Inorganic Chemistry)

Time: 2 Hours **Full Marks: 40**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer *any five* questions: 2×5=10

(a) State the conditions for orbital contribution to the magnetic moment.

(b) What will be the increasing order of Δ_{3p} for complexes $[Ni(CN)_4]^{2-}$, $[Pd(CN)_4]^{2-}$ and $[Pt(CN)_4]^{2-}$? Given reason(s).

(c) For which complex spin state equilibrium may occur — $[Co(CN)_6]^{4-}$; $[CuCl_6]^{4-}$; $[Ni(CO)_4]$ and $[PtCl_4]^{2-}$? Give reason

(d) Why do 4d and 5d metals form square planar complexes rather than tetrahedral complexes?

(e) Write down general electronic configuration of transition elements and actinides. Hence indicate the effect of lanthanide type contraction in both cases.

(f) Draw Orgel diagram of d^7 O_h and d^9 T_d complexes.

(g) Why are compounds of lanthanides and actinides are coloured?

(h) '$[Co(H_2O)_6]^{2+}$ forms $[CoCl_4]^{2-}$ but $[Ni(H_2O)_6]^{2+}$ does not forms $[NiCl_4]^{2-}$.'— Why?

2. Answer *any two* questions: 5×2=10

(a) (i) 'Tetrahedral complexes are always high spin.'— Explain.

(ii) 'Carbonyl' and 'Phosphine'— the bread and butter ligand for first transition series, are not good ligands for lanthanides.'— Explain. 2½+2½

(b) (i) Which will show greater Δ_0 value among the pairs and why? (A) $[Co(CN)_6]^{3-}$ and $[Co(CN)_6]^{4-}$ (B) $[Co(CN)_6]^{3-}$ and $[CoCl_6]^{3-}$.

(ii) Give example of one high spin square planar complex. Draw its structure and give its *d*-orbital splitting pattern. (½+½+½+½)+3

(c) (i) Electronic configuration of Cu^+ and Cu^{2+} is [Ar] $3d^{10}$ and [Ar] $3d^9$, respectively. Through Cu^+ has filled valence shell but it is less stable than Cu^{2+}. —Why?

(ii) Why do transition elements show variable valency? 2½+2½

(d) (i) Why are common oxidation state of 3d series metal ions (except Sc and Cu) +2?

(ii) Why are absorption band of lanthanides very sharp where as that of transition metal compounds broad? 2½+2½

3. Answer *any two* questions: 10×2=20

(a) (i) Why is the cause of Jahn-Teller distortion?

(ii) In octahedral geometry among Co^{2+} high spin or Co^{2+} low spin complex, which one will face more Jahn-Teller distortion?

(iii) Why Pt(II) and Pd(II), though symmetrically field, undergoes Jahn-Teller distortion?

(iv) Why does Cu(II) experience distortion even for weak field ligand but Ni(II) system experience it only with strong field ligand?

(v) Which type of distortion is preferred by Cu(II) complexes? Give reason. 2+2+2+2+2

(b) (i) Discuss the structure and bonding of $[Cr(CH_3COO)_2]_2.2H_2O$ and $[Cu(CH_3COO)_2]_2, 2H_2O$. Also discuss their magnetic moment.

(ii) Why is separation of lanthanide ions a difficult task?

(iii) '2nd and 3rd row transition metals are very much close in their chemical properties'—why? (1+1+1+1+1+1)+2+2

(c) (i) Draw the crystal field splitting pattern for d^8 configuration in octahedral, tetrahedral and square planner electronic field.

(ii) Calculate CFSE in weak and strong crystal field for d^7 configuration in octahedral, tetrahedral and square planner electronic field. (1½+1½+2)+(1½+1½+1+1)

(d) (i) What is magnetically concentrated compound and magnetically dilute compound? Explain with example.

(ii) Explain quenching of magnetic moment with example.

(iii) What is super exchange phenomenon—state with example.

(iv) Give elementary idea on antiferromagnetism with example. (2+2)+2+2+2
