3 Yr. Degree/4 Yr. Honours 5th Semester Examination, 2025 (CCFUP)

Subject : Chemistry

Course : CHEM 5011 (MAJOR)

(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) 'Mn_3O_4 is normal spinel, whereas Fe_3O_4 is inverse spinel.'— Why?

(b) 'Copper(II) acetate dihydrate has unexpectedly low magnetic moment (spin-only value).' — State reason.

(c) What is the reason for very light pink colour of $[Mn(OH_2)_6]^{2+}$?

(d) Draw Orgel diagram(s) of d^6 O_h and T_d complexes.

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

(f) Define nuclear isomerism with example.

(g) What do you mean by packing fraction?

(h) Calculate ground state term symbols for Cr^{3+} and Mn^{2+}.

2. Answer *any two* questions: 5×2=10

(a) (i) What do you mean by Curie point and Neel point in magnetism?

(ii) Define ferromagnetism and antiferromagnetism with example of each. 2+3

(b) (i) What are MLCT and LMCT transitions? Explain with suitable examples.

(ii) Cite an example of super-exchanged pathway with respect to a coordination molecule. What is the net effect? 3+2

(c) (i) Compare the crystal field splitting pattern(s) of O_h and T_d crystal fields.

(ii) Draw the structure of $[Ni(dmgH)_2]$ and calculate its CFSE value. 3+2

[$dmgH_2$ = dimethylglyoxime]

(d) (i) Explain the electronic spectrum of $[Ti(H_2O)_6]^{3+}$.

(ii) 'Cu(I) compounds show disproportionation reaction.'— Why? 3+2

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

(a) (i) 'The lanthanide elements show the common stable oxidation state of +3.'— State briefly.

(ii) 'Sm(III) and Eu(III) show exceptional magnetic behaviour with respect to other trivalent lanthanide cations.'— Explain.

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

(iv) 'Cu(II) complexes are Jahn-Teller active.'— Justify. 2+3+3+2

(b) (i) Write the selection rules for electronic transitions.

(ii) Write the factors on which crystal field parameter depends.

(iii) 'OH^- ion is in lower position than H_2O in spectrochemical series.'— Explain.

(iv) 'Generally tetrahedral metal complexes are of high spin.'— Why? 2+3+3+2

(c) (i) What are mirror nuclei? Give example.

(ii) 'Lighter elements generally undergo fusion whereas heavier elements show nuclear fission.'— Justify using binding energy curve.

(iii) A wood specimen from an archaeological sample shows a $^{14}_{6}C$ activity of 3.8 counts per minute per gram of carbon. Freshly cut wood gives 15.3 counts per minute per gram of carbon. Calculate the age of the specimen.

(iv) Write the energy terms involved in liquid drop model. 2+3+3+2

(d) (i) Define homopolymers and heteropolymers with examples.

(ii) Write some differences between inorganic polymer and organic polymer.

(iii) 'Borazine is called inorganic benzene.'— Justify.

(iv) Comment on the applications of phosphazenes. 3+2+3+2
