TDC (CBCS) Even Semester Exam., 2025

CHEMISTRY

(4th Semester)

Course No. : CHMHCC–401

(Coordination Chemistry and its Application)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

UNIT—I

1. Answer any *two* of the following questions : 2×2=4

(a) State the basic postulates of crystal field theory.

(b) How are structure and magnetic nature of $[FeF_6]^{3-}$ explained in terms of valence bond theory?

(c) Show the crystal field splitting of $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$.

2. Answer any *one* of the following questions : 6

(a) *(i)* Write a note on the application of coordination compounds in analytical chemistry. 3

(ii) Using VBT, explain the formation of $[CoF_6]^{3-}$ and $[Fe(CN)_6]^{4-}$ ions. 3

(b) *(i)* Calculate CFSE of each of the following and compare the stability between $[Co(NH_3)_6]^{2+}$ and $[Co(NH_3)_6]^{3+}$. 3

(ii) Draw a σ-bond molecular-orbital diagram for octahedral $[Co(NH_3)_6]^{3+}$ complex and show the energy gap Δ_0. 3

UNIT—II

3. Answer any *two* of the following questions : 2×2=4

(a) What are the ambidentate ligands? Give an example. 1+1=2

(b) Draw the structure and indicate the types of isomer formed by the complex $[Co(NH_3)_4Cl_2]Cl$. 2

(Continued)

(c) Write the IUPAC names (2005) of the following : 1×2=2

(i) $[Pt(NH_3)_4][PtCl_4]$

(ii) $[Co(en)_2(ONO)Cl]Cl$

4. Answer any *one* of the following questions : 6

(a) (i) What is meant by isomerism? Name and explain various types of geometrical isomerism exhibited by coordination compound. 3

(ii) Briefly describe the three factors that influence formation of complexes. 3

(b) (i) Give the possible stereochemistries for coordination number 4 with an example each. 3

(ii) How does colour change principle help in detection of complex formation? 3

UNIT—III

5. Answer any *two* of the following questions : 2×2=4

(a) Calculate the number of unpaired electrons in the ground state of Cr^{3+} and Sc^{3+} ions. 1+1=2

(b) $[Ti(H_2O)_6]^{3+}$ is coloured while $[Sc(H_2O)_6]^{3+}$ is colourless. Give reasons. 2

(c) Why is Mn (II) not stable in aqueous solution? 2

6. Answer any *one* of the following questions : 6

(a) (i) Write two characteristic properties of transition elements. 2

(ii) Why do transition metals show variable valencies? 2

(iii) Calculate the magnetic moment value of Ti^{3+} ion. 2

(b) Explain giving reasons : 2×3=6

(i) Transition metals and many of their compounds show paramagnetic behaviour.

(ii) Transition metals generally form coloured compounds.

(iii) Transition metals and their many compounds act as good catalysts.

UNIT—IV

7. Answer any *two* of the following questions : 2×2=4

(a) Why does Eu exhibit +2 oxidation state instead of +3 oxidation state?

(b) Why are La^{3+} and Ce^{4+} diamagnetic in nature?

(c) $La(OH)_3$ is more basic than $Lu(OH)_3$. Explain.

8. Answer any *one* of the following questions : 6

(a) *(i)* What are the *f*-block elements? 2

(ii) Why Zr and Hf have almost equal atomic and ionic radii? 2

(iii) Why is it difficult to separate lanthanides from each other? 2

(b) *(i)* What are lanthanides and actinides? 2

(ii) Why is the +3 oxidation states of lanthanides are most stable? 2

(iii) Write a brief note on complexation of actinides. 2

UNIT—V

9. Answer any *two* of the following questions : 2×2=4

(a) What are essential trace elements in living organism? Give an example. 1+1=2

(b) Define porphyrin. Give one example of metalloporphyrin. 1+1=2

(c) What is chelation therapy? 2

10. Answer any *one* of the following questions : 6

(a) *(i)* Name one metalloporphyrin and state its biofunction explaining the role of metal ion in it. 1+2=3

(ii) What are heavy metals? Explain the toxic effects of mercury on human health. 1+2=3

(b) *(i)* "*cis*-platin shows anticancer activity but *trans*-platin does not." Justify. 2

(ii) Explain the idea of elemental deficiency in biological systems. 2

(iii) Can a metal be toxic as well as essential for a living being? Explain with example. 2

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