

**2025/TDC(CBCS)/EVEN/SEM/
CHMHCC-401/243**

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 $[\text{FeF}_6]^{3-}$ explained in terms of valence bond theory?

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

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 $[\text{CoF}_6]^{3-}$ and $[\text{Fe}(\text{CN})_6]^{4-}$ ions. 3

(b) (i) Calculate CFSE of each of the following and compare the stability between $[\text{Co}(\text{NH}_3)_6]^{2+}$ and $[\text{Co}(\text{NH}_3)_6]^{3+}$. 3

(ii) Draw a σ -bond molecular-orbital diagram for octahedral $[\text{Co}(\text{NH}_3)_6]^{3+}$ complex and show the energy gap Δ_0 . 3

UNIT—II

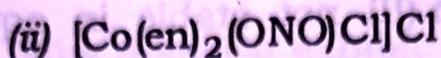
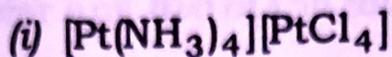
3. Answer any two of the following questions : 2×2=4

(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 $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$. 2

(Continued)

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



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) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is coloured while $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ 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 : $2 \times 3 = 6$

- (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) $\text{La}(\text{OH})_3$ is more basic than $\text{Lu}(\text{OH})_3$. 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

(6)

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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J25—230/1024

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