

**2024/TDC (CBCS)/EVEN/SEM/
CHMHCC-401T/302**

TDC (CBCS) Even Semester Exam., 2024

CHEMISTRY

(4th Semester)

Course No. : CHMHCC-401T

(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 questions : 2×2=4

- (a) Draw crystal-field splitting diagram of a square-planar complex.**
- (b) Calculate the CFSE (Dq) for a d^4 high-spin octahedral system.**
- (c) Write the factors affecting the magnitude of crystal field splitting.**

(2)

2. Answer any one question :

6

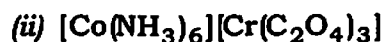
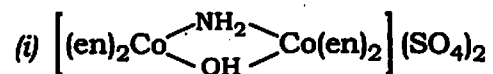
- (a) (i) Compare the CFSE of $\text{Co}(\text{H}_2\text{O})_6^{12+}$ and $\text{Co}(\text{NH}_3)_6^{13+}$ in terms of Δ_o and P . 3
- (ii) Explain the consequence of Jahn-Teller effect on the structure of CuCl_6^{14-} . 3
- (b) (i) Based on CFT, predict the magnetic moment of $[\text{Ni}(\text{NH}_3)_4]\text{SO}_4$. 3
- (ii) What is spectrochemical series? Calculate and comment on the CFSE of $\text{Fe}(\text{H}_2\text{O})_6^{12+}$. 1+2=3

UNIT—II

3. Answer any two questions :

2×2=4

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



- (b) Distinguish between ambidentate and flexidentate ligands with suitable examples.

(3)

- (c) What is chelate complex? Give an example. 1+1=2

4. Answer any one question :

6

- (a) (i) What is meant by terminal ligand? Compare such a ligand with a bridging ligand. Define nuclearity of a complex. 1+1+1=3
- (ii) Taking suitable example, describe the possible stereochemistries for a complex of type $[\text{ML}_5]$. 3
- (b) (i) What is meant by flexidentate character of polydentate ligand? Give example. 3
- (ii) What type of isomerism is exhibited by $[\text{Co}(\text{NH}_3)_5\text{X}]\text{Cl}_2$ ($\text{X} = \text{NO}_2$)? Give the formula and IUPAC nomenclature of the isomers. 3

UNIT—III

5. Answer any two questions :

2×2=4

- (a) Compounds of Mn(VII) are intensely coloured while those of Mn(II) are almost colourless. Explain.

(4)

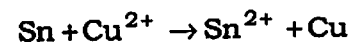
- (b) Why are 4d and 5d elements chemically so similar?
- (c) $\text{Cu}(\text{NH}_3)_4^{2+}$ is intense blue in colour. Explain.

6. Answer any one question : 6

- (a) (i) What is chromyl chloride test? Can this test be performed on aqueous solution containing Cl^- ? 2
- (ii) Why does chromium exist as $\text{Cr}_2\text{O}_7^{2-}$ in acidic medium, whereas in alkaline medium as CrO_4^{2-} ? 2
- (iii) Which one of Cr^{2+} or Cr^{3+} is stable in aqueous solutions? Give reasons. 2
- (b) (i) Give reasons why—
- (1) in aqueous solution, Cu(I) having d^{10} configuration is less stable than Cu(II) having d^9 configuration;
 - (2) ZnO is yellow when hot and white when cold;
 - (3) Zn^{++} compounds are colourless. 1+1+1=3

(5)

- (ii) Examine feasibility of the reaction



given that $E_{\text{Sn}^{2+}/\text{Sn}}^\circ = -0.136 \text{ V}$ and

$E_{\text{Cu}^{2+}/\text{Cu}}^\circ = +0.34 \text{ V}$. 2

- (iii) Comment on the colour of scandium(III) ion. 1

UNIT—IV

7. Answer any two questions : 2×2=4

- (a) Write down the sets of quantum numbers that define the 4f atomic orbitals.
- (b) What is meant by lanthanide contraction?
- (c) Discuss the main differences in the chemistry of lanthanides and actinides.

8. Answer any one question : 6

- (a) (i) Lanthanum exhibits +3 oxidation state, whereas certain other elements of lanthanum series show +2 and +4 also. Explain. 3

(6)

- (ii) "Although Ce^{3+} has f -electron, it does not show colour." Explain. 2
- (iii) Mention two applications of lanthanide materials. 1
- (b) (i) Write general electronic configuration of lanthanides and explain the trends in ionic radii of M^{3+} of this class. 1+2=3
- (ii) Why is Ce^{4+} a strong oxidizing agent whereas Sm^{2+} is a reducing agent? 3

UNIT—V

9. Answer any two questions : 2×2=4

- (a) Define essential elements in biological system. Give two examples of essential trace elements. 1+1=2
- (b) Describe the toxic effects of CN^- ion on human health.
- (c) Discuss the role of iron in biological function.

10. Answer any one question : 6

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

(7)

- (ii) What are the functions of hemoglobin and myoglobin in biological system? 3
- (b) (i) What is chelation therapy? Give one example of its application in detoxification of lead and arsenic. 1+1+1=3
- (ii) Can a metal be toxic as well as essential for a living being? Explain with example. 2
- (iii) Suggest one antidote for mercury poisoning. 1
