

**UG 5th Semester Examination 2021****CHEMISTRY (Honours)**

**Paper : DC-11  
(Inorganic)  
(CBCS)**

*The figures in the margin indicate full marks. Candidates are required to give their answers in their own words as far as practicable.*

**Full Marks: 25**

**Time: Two Hours**

1. Answer any *five* questions from the following:

(1 × 5) = 5

a) For  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ ,  $10Dq$  can be calculated from the transition energy corresponds to

i)  ${}^3T_{2g} \leftarrow {}^3A_{2g}$

ii)  ${}^3T_{1g}(\text{F}) \leftarrow {}^3A_{2g}$

iii)  ${}^3T_{1g}(\text{P}) \leftarrow {}^3A_{2g}$

iv)  ${}^3T_{2g} \leftarrow {}^3E_g$

b) Which of the following elements is not a lanthanoid

(i) Er

(ii) Pu

(iii) Tm

(iv) Tb

c) Which of the following electronic systems will exhibit Jahn-Teller distortion in high spin Octahedral system?

i)  $d^3$

ii)  $d^5$

iii)  $d^8$

iv)  $d^2$

d) Unlike d-d transitions, the f-f transitions

- (i) do not change much with change in ligand
- (ii) change significantly with change in ligand
- (iii) appear at low energies i.e., at the near-IR region
- (iv) appear as broad bands

e) The complex ion with the highest crystal field splitting energy

- (i)  $[\text{Co}(\text{NH}_3)_6]^{2+}$
- (ii)  $[\text{Rh}(\text{NH}_3)_6]^{3+}$
- (iii)  $[\text{Ir}(\text{NH}_3)_6]^{3+}$
- (iv)  $[\text{Co}(\text{NH}_3)_6]^{3+}$

f) Which of the following complexes is diamagnetic?

- i)  $[\text{Fe}(\text{CN})_6]^{4-}$
- ii)  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
- iii)  $[\text{CoF}_6]^{3-}$
- iv)  $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$

g) Which one of the following will be least stable among following actinyl ions?

- (i)  $\text{PuO}_2^{2+}$
- (ii)  $\text{NpO}_2^+$
- (iii)  $\text{PuO}_2^+$
- (iv)  $\text{NpO}_2^{2+}$

h) Colour of Prussian blue arises due to

- (i) d-d transition
- (ii) metal to ligand charge transfer
- (iii) ligand to metal charge transfer
- (iv) metal to metal charge transfer

2. Answer any *four* questions

(4 × 2) = 8

- (a) The complexes  $[\text{NiCl}_2(\text{PPh}_3)_2]$  and  $[\text{PdCl}_2(\text{PPh}_3)_2]$  are paramagnetic and diamagnetic respectively. What can you conclude about their structures from this statement?
- (b) Indicate the spectral transitions for a  $3d^9$  ion in weak octahedral environment from Orgel diagram.
- (c) What do you mean by 'dynamic Jahn-Teller effect'? Give example.
- (d) Justify the position of  $\text{I}^-$  and  $\text{CN}^-$  in the spectrochemical series.
- (e)  $\text{Cu(II)}$  acetate monohydrate shows subnormal magnetic moments at room temperature. Explain.
- (f) Although lanthanoids usually exhibit + 3 oxidation state, Eu and Yb have a high stability in their + 2 oxidation state. Comment.
- (g) What happens when gold chloride solution is treated with stannous chloride solution.
- (h) How does nephelauxetic effect in complexes reduce the pairing energy (P)?

3. Answer any *two* questions

(6 × 2) = 12

- (a) (i) Explain in brief the outline of ion-exchange method of separation of lanthanoids. [3]
- (ii) The colour of  $\text{Mn}^{2+}$  salts are pale pink while  $\text{KMnO}_4$  is deep purple. Explain the origin of colour in both the cases and their intensity. [3]
- (b) (i) Octahedral  $\text{Ni(II)}$  complexes have magnetic moment in the range 2.9-3.4 B.M. Tetrahedral complexes of  $\text{Ni(II)}$  have magnetic moment up to 4.1 B.M. Rationalize the observation. [3]
- (ii) Spectral features of 4f complexes have a marked difference from their 3d counterpart. Mention the differences. [3]
- (c) (i) Predict the type of spinel structure adopted by  $\text{Fe}_3\text{O}_4$  and  $\text{Co}_3\text{O}_4$ . [3]
- (ii) Compare the magnetic properties of lanthanoids and actinoids. [3]
- (d) (i) Compare Cu, Ag, Au with respect to stability of their oxidation states. [3]
- (ii) Electronic absorption spectrum of  $\text{CoF}_6^{3-}$  shows two maxima in the visible region at 11,500 and  $14,500 \text{ cm}^{-1}$ . Account for the cause of bands and expected colour of the complex ion. [3]