

**B.Sc. Semester-V Examination, 2022-23****CHEMISTRY [Honours]**

Course ID : 51411 Course Code : UG/CHEM/501/C-11

Course Title : Inorganic Chemistry (IV)

Time : 1 Hour 15 Minutes

Full Marks : 25

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.*1. Answer any **five** of the following questions:

1×5=5

- a) Write down the selection rules for electronic transitions in absorption spectroscopy.
- b) Give an example of a high spin Co(III) complex.
- c) Deduce ground-state term symbol for Co(III).
- d) Calculate spin-only magnetic moment of  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ .
- e) Can lanthanum ion exist in (+4) oxidation state? Justify.

- f) Write the general electronic configurations of lanthanoids and actinoids.
- g) What is Neel temperature?
- h) The terms of  $d^2$  configuration are  $^1\text{S}$ ,  $^3\text{P}$ ,  $^1\text{D}$ ,  $^3\text{F}$  and  $^1\text{G}$ . Which one of these has the highest energy?

2. Answer any **two** of the following questions:

5×2=10

- a) i) With the help of an Orgel diagram, explain how many absorption bands are expected in the electronic spectra of  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ . Label the energy levels and assign the transitions.
- ii) Write two important limitations of Orgel energy level diagram. 3+2=5
- b) i) Draw a Plot of  $\frac{1}{\chi}$  vs T(k) for materials which obey- Curie law; Curie-Weiss law for a ferromagnetic material and Curie-Weiss law for an antiferromagnetic material.

ii) What are the factors that affect the magnitude of crystal field splitting?

3+2=5

c) i)  $[\text{NiCl}_4]^{2-}$  is paramagnetic while  $[\text{NiCN}_4]^{2-}$  is diamagnetic—Explain. Comment on their geometry.

ii) Explain why d-d transitions are different from f-f transitions?

3+2=5

d) i) A light pink aqueous Co(II) chloride solution becomes deep blue on addition of excess HCl. Account for the fact.

ii) State the origin of color in  $[\text{Fe}(\text{bpy})_3]^{2+}$  and  $[\text{FeO}_4]^{2-}$  ions.

3+2=5

3. Answer any **one** of the following question:

10×1=10

a) i) Compare the chemistry of lanthanides and actinides with reference to tendency to form complexes.

ii) Which one among  $\text{La}(\text{OH})_3$  and  $\text{Lu}(\text{OH})_3$  is stronger base and why?

iii) Hexaaqua iron(III) is nearly colourless while it turns blood red colour upon addition of KSCN— Explain.

iv) Calculate CFSE with pairing energy (P) for  $[\text{Co}(\text{NH}_3)_6]^{3+}$ .

v) Atomic radii of V, Nb and Ta are 122, 134 and 134 pm respectively. Comment.

2×5=10

b) i) What is nephelauxetic effect and what is the empirical formula to calculate the Racah parameter for different metal ions in complexation?

ii) Pentavalent uranium has a strong tendency to disproportionate— comment.

iii) Mention the effect of pH on Chromate-dichromate equilibrium.

iv) Tc (VII) and Re(VII) are less oxidising whereas Mn(vii) is strongly oxidising. —Explain.

v) What will be the CFSE for tetrahedral  $[\text{CoCl}_4]^{2-}$  if the CFSE of octahedral  $[\text{CoCl}_6]^{4-}$  is  $1800 \text{ cm}^{-1}$ ?

2×5=10

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