Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2024

Course: Inorganic Chemistry-III **Semester : IVth**
Program: B.Sc. (H) Chemistry **Time : 03 hrs.**
Course Code: CHEM2004 **Max. Marks: 100**

Instructions:

i) Read questions carefully.
ii) Section B and Section C have internal choice questions.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	(a) In which of the following species does the transition metal ion have d^5 electronic configuration? (i) $[Cr(NH_3)_6]^{3+}$ (ii) $[Co(H_2O)_6]^{2+}$ (iii) $[CoF_6]^{3-}$ (iv) $[Fe(CN)_6]^{3-}$ (b) Which one of the following statements is FALSE? (i) In an octahedral crystal field, the *d* electrons on a metal ion occupy the e_g set of orbitals before they occupy the t_{2g} set of orbitals. (ii) Diamagnetic metal ions cannot have an odd number of electrons. (iii) Low spin complexes can be paramagnetic. (iv) Low spin complexes contain strong field ligands.	**2+2**	**CO1**
Q 2	Calculate the crystal field stabilization energy (CFSE) value for the following systems: (i) d^4 low spin octahedral and (ii) d^5 high spin octahedral	**4**	**CO1** **CO2**
Q 3	Give the general electronic configuration of lanthanides. Explain the anomalous oxidation states of 2+ and 4+ shown by some elements in the series.	**4**	**CO1**
Q 4	(a) Which of the following orders correctly describes the tendency of a ligand to direct ligand substitution in a square planar complex to a position opposite to itself? (i) $[CN]^- > [NO_2]^- > Br^- > NH_3$ (ii) $[CN]^- > Br^- > NH_3 > [NO_2]^-$	**2+2**	**CO3**

	(iii) $[NO_2]^-$ > $[CN]^-$ > NH_3 > Br^- (iv) Br^- > $[CN]^-$ > NH_3 > $[NO_2]^-$ (b) Which statement is correct? (i) A dissociative mechanism is a 2-step mechanism with the leaving group departing in the second step (ii) An associative mechanism is a 2-step mechanism; the intermediate has a lower coordination number than the starting complex (iii) In a dissociative interchange mechanism, bond breaking dominates over bond formation (iv) In an associative interchange mechanism, the entering group associates with the substrate after the leaving group has departed.		
Q 5	Discuss three important factors influencing the magnitude of crystal field stabilization energy (CFSE) in octahedral complexes.	**4**	
SECTION B (4Qx10M= 40 Marks)			
Q 6	Construct and discuss the σ-bonding molecular orbital diagram for a complex in an octahedral environment. Highlight the frontier molecular orbitals (HOMO and LUMO) in its MO diagram.	**10**	**CO2**
Q 7	Explain *Jahn-Teller* distortion present in case of d^9 and d^8 low spin systems. OR d^8 low spin metals never form octahedral complexes. Why it is so?	**10**	**CO1**
Q 8	What is lanthanide contraction? What are its important consequences?	**10**	**CO1**
Q 9	Define *trans effect* in square planar complexes. Write down the reactions involved in the preparation of *cis*- and *trans*-$[Pt(NH_3)_2Cl_2]$ by following *trans effect* series of the ligands.	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q 10	What are inert and labile complexes? How will you explain the lability or inertness in case of following complex ions using valence bond theory? (i) $[MnCl_6]^{3-}$ (ii) $[Co(CN)_6]^{3-}$	**20**	**CO1 CO3**

Q 11	What are the nucleophilic substitution reactions that are involved in coordination compounds? Discuss the dissociative and associative mechanisms for octahedral complexes. OR Explain the following statements: (i) Square planar complexes generally do not exhibit optical isomerism. (ii) Tetrahedral complexes do not show geometrical isomerism. (iii) Zr and Hf have almost similar atomic radii. (iv) Ce^{4+} is a good oxidizing agent.	**20**	**CO3**