

Roll No.....

JAMIA HAMDARD  
DEPARTMENT OF CHEMISTRY  
SCHOOL OF CHEMICAL & LIFE SCIENCES  
BSC. HONS. CHEMISTRY (FYUP), CHEMISTRY  
SEMESTER IV EXAMINATION-2025  
PAPER TITLE: TRANSITION AND INNER TRANSITION METAL CHEMISTRY AND  
GROUP THEORY  
PAPER CODE: BCH-DSC401 TH

Time: 2 ½ hours

Maximum Marks: 60

**Abbreviations Used:** CLO- Course Outcome, PLO- Program Outcome, BTL- Bloom Taxonomy Level: BT level 1-Remember; BT level 2-Understand; BT level 3-Apply; BT level 4-Analyse; BT level 5-Evaluate, BT level 6-Create.

| Q. No.                                                    |                                                                                                                                                | BTL                    | CLO | PLO |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----|-----|
| <b>SECTION A</b>                                          |                                                                                                                                                |                        |     |     |
| <b>Very Short Type Questions (Attempt all):</b>           |                                                                                                                                                | <b>(1x15=15 marks)</b> |     |     |
| A1                                                        | What is the effective atomic number (EAN) rule?                                                                                                | 1                      | 1   | 1-2 |
| A2                                                        | Why is $[\text{Fe}(\text{CN})_6]^{4-}$ diamagnetic but $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ paramagnetic?                                  | 2                      | 2   | 1-2 |
| A3                                                        | Calculate CFSE for $d^6$ (strong field).                                                                                                       | 2                      | 2   | 3   |
| A4                                                        | Explain back bonding in $[\text{Ni}(\text{CO})_4]$ .                                                                                           | 2                      | 2   | 2   |
| A5                                                        | Why is $[\text{Cu}(\text{NH}_3)_4]^{2+}$ square planar?                                                                                        | 2                      | 2   | 3   |
| A6                                                        | What is the Jahn-Teller theorem?                                                                                                               | 2                      | 2   | 3   |
| A7                                                        | Why do lanthanides show +3 oxidation state?                                                                                                    | 1                      | 2   | 2   |
| A8                                                        | What is the lanthanide contraction?                                                                                                            | 1                      | 2   | 3   |
| A9                                                        | GIVE IUPAC name of $\text{K}_3[\text{Fe}(\text{CN})_6]$ .                                                                                      | 1                      | 1   | 1   |
| A10                                                       | Why is $[\text{Co}(\text{en})_3]^{3+}$ optically active?                                                                                       | 2                      | 3   | 3   |
| A11                                                       | What is the trans effect? Give an example.                                                                                                     | 1                      | 1-2 | 1-2 |
| A12                                                       | Why are tetrahedral complexes usually high-spin?                                                                                               | 2                      | 2-3 | 3   |
| A13                                                       | Compare thermodynamic vs. kinetic stability.                                                                                                   | 2                      | 3   | 2-3 |
| A14                                                       | Discuss role of $\pi$ -acceptor ligands in CFT.                                                                                                | 2                      | 2   | 2   |
| A15                                                       | Define improper axis of rotation ( $S_n$ ).                                                                                                    | 1                      | 1-2 | 2   |
| <b>SECTION B</b>                                          |                                                                                                                                                |                        |     |     |
| <b>Long Type Questions (Attempt any two out of four):</b> |                                                                                                                                                | <b>(10x2=20 marks)</b> |     |     |
| B1                                                        | (a) CFT for tetrahedral vs. octahedral complexes.<br>(b) Give factors affecting pairing energy.                                                | 3                      | 1-3 | 1-3 |
| B2                                                        | (a) Give Latimer diagram for Cr.<br>(b) Explain Ion-exchange method for lanthanides.                                                           | 4-6                    | 2-6 | 4-6 |
| B3                                                        | (a) Discuss mechanism of ligand substitution in octahedral complexes.<br>(b) Explain Trans effect in $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ . | 3-4                    | 3-5 | 3-5 |
| B4                                                        | (a) Draw MO diagram for $[\text{CoF}_6]^{3-}$ .<br>(b) Explain IR-active vibrations for octahedral $[\text{Co}(\text{NH}_3)_6]^{3+}$ .         | 4-5                    | 3-6 | 3-6 |
| <b>SECTION C</b>                                          |                                                                                                                                                |                        |     |     |
| <b>Short Type Questions (Attempt all Questions):</b>      |                                                                                                                                                | <b>(5x5=25 marks)</b>  |     |     |
| C1                                                        | (a) Give Werner's theory vs. VBT.<br><b>OR</b><br>(b) Explain Isomerism in $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ .                           | 3-5                    | 4-5 | 4-5 |
| C2                                                        | (a) Give the Base hydrolysis mechanism.                                                                                                        | 3                      | 4   | 3-4 |

|           |                                                                                                                                     |     |     |     |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|
|           | <b>OR</b><br>(b) Discuss the Trans influence series.                                                                                |     |     |     |
| <b>C3</b> | (a) Give in detail for colour of transition metal complexes.<br><b>OR</b><br>(b) Calculate CFSE for $d^5$ (high-spin vs. low-spin). | 4-6 | 4   | 4-5 |
| <b>C4</b> | (a) Compare Ti(IV) and V(V) stability.<br><b>OR</b><br>(b) Why is $Mn^{2+}$ pale pink?                                              | 3-4 | 2-3 | 3-5 |
| <b>C5</b> | (a) Give the Redox reactions in $[Co(NH_3)_5Cl]^{2+}$ .<br><b>OR</b><br>(b) Draw a Character table for $C_{2v}$ point group.        | 5-6 | 3-6 | 4-6 |

-----