[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6479 **L**

Unique Paper Code : 2174001203

Name of the Paper : GE: Coordination and Organometallic Compounds

Name of the Course : **B.Sc. (H)**

Semester : II/IV/VI

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **4** questions in all. **All** the questions carry equal marks.
3. The questions should be numbered in accordance to the number in the question paper.
4. Calculators and log tables may be used.

1. **(a)** $[Ni(CN)_4]^{2-}$ is a square planar complex and not tetrahedral. Explain on the basis of VBT.

(b) Give the structure of $Fe(CO)_5$ and $Ni(CO)_4$ with valence bond approach.

(c) What is spectrochemical series? Distinguish between strong field and weak field ligand giving examples (6, 5, 4)

2. **(a)** In a carbonyl complex with a linear OC – M – CO group, how will the CO stretching frequency change when

(i) One CO is replaced by triethylamine

(ii) A positive charge is put on the complex

(iii) If the complex is given a negative charge

(b) Arrange the following species in the order of increasing Jahn-Teller distortion in an octahedral environment: high-spin Co(III), low-spin Co(II), Cu(II) and Ti(III). justify your answer.

(c) Predict whether the following obey the EAN rule:

$[Mn(C_2H_4)(CO)_5]^+$, $[Co(\pi\text{-}C_3H_5)(CO)_3]$, $Cr(CO)_6$ and $[V(CO)_6]$, (6, 5, 4)

3. **(a)** Explain the following:

(i) The C- O bond length in metal carbonyls are longer than that in CO.

(ii) The 18-electron rule for the 3d metals followed in the middle of the series.

(iii) NO^+ is a stronger π acceptor than CO while CN^- is weaker.

P.T.O.

(b) Draw the structure of methyl lithium. In which category of organometallic compounds will you place it? What are the coordination numbers of Li and C in the tetramer?

(c) What is the cause of distortion with some octahedral complexes? The high-spin octahedral complexes of Ni^{2+} ion are not expected to show distortion, whereas low-spin octahedral complexes of Ni^{2+} show strong distortion. Explain. (6, 5, 4)

4. (a) Differentiate between ionic and covalent sigma bonded organometallic compounds giving suitable example.

(b) Write IUPAC names of the following complexes.

(i) $[Pt(NH_3)_4Cl_2][PtCl_4]$

(ii) $[Cr(NCS)_4(NH_3)_2]^-$

(iii) $[Ni(en)_2(NH_2)_2]$

(iv) $[Cr(NH_3)_2(H_2O)_4]$

(v) $[Cr(H_2O)Cl_2]Cl$

(c) Give two examples for the preparation of metal carbonyls by reductive carbonylation. (6, 5, 4)

5. (a) What are inner and outer orbital complexes? Give two examples of each.

(b) Define 18-electron rule. Show that $Fe_3(CO)_{12}$ obeys 18 electron rule.

(c) Write a short note on valence bond theory. (6, 5, 4)

6. (a) $[FeF_6]^{3-}$ has higher magnetic moment than $[Fe(CN)_6]^{3-}$, though both are octahedral complex ions. Explain on the basis of CFT. Draw the crystal field splitting of d- orbitals for both the complex ions.

(b) Calculate the crystal field stabilization values for high spin and low spin octahedral complexes of (i) d^4 ion and (ii) d^7 ion.

(c) Answer the following:

(i) Apart from CO give an example of a π – acid ligand.

(ii) Through which atom does CO act as an electron pair donor?

(iii) Through which atom does CO act as an electron pair acceptor?

(iv) Why is CO a π acid ligand? (6, 5, 4)