(c) How will you differentiate between the terminal CO and bridging CO?

(d) Complexes with chelating ligands are more stable than the complexes with non-chelating ligands. Explain, with a suitable example. (5,4,3,3)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4653 **J**

Unique Paper Code : 2174001203

Name of the Paper : GE: Coordination and Organometallic Compounds

Name of the Course : **All Undergraduate Courses Except with Chemistry**

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 any **four** questions.
3. **All** questions carry equal marks.

1. (a) For Mn^{3+} ion, mean pairing energy P is found to be 28000 cm^{-1}, Δ_o values for the complex $[Mn\ (H_2O)_6]^{3+}$ and $[Mn\ (CN)_6]^{3-}$ are 21000 and 38500 cm^{-1} respectively. Do these complexes have low spin or high spin configuration? Also write down the configuration corresponding to these states.

(b) What is meant by synergic effect? How does it account for the formation of carbonyl complexes of transition metals in low oxidation states.

(c) Ni (II) is stabilized in the formation of square planar rather than octahedral geometry in the presence of strong field ligands. Explain why?

(d) Predict whether the following obey EAN rule and explain

H Mn $(CO)_5$, $[Co\ (CO)_3(\eta^3\text{-}C_3H_5)]$, $Rh_2(CO)_4Cl_2$

(5,4,3,3)

2. (a) Discuss how does CO behave as σ donor and π acceptor, through carbon atom in metal carbonyls, with reference to MO diagram.

(d) Define Jahn-Teller theorem. Giving reasons, explain in which case this effect would be observed?

$t_{2g}^3 e_g^1$ or $t_{2g}^6 e_g^2$ (5,4,3,3)

6. (a) How will you rationalise the increase in C-C bond length from 133.7 pm in ethene to 137.5 pm in Ziese's salt, accompanied by a decrease in C-C stretching frequency from 1623 cm-1 to 1526 cm–1?

(b) Give the IUPAC names of the following complexes **(any four)** :

(i) $K_4[Fe\ (CN)_6]$

(ii) $[Cr\ (ONO)(NH_3)_2Br_2H_2O]$

(iii) $[Co\ (NH_3)_5Cl]\ Cl_2$

(iv) $Na_2[ZnCl_4]$

(v) $K_2\ [OsNCl_5]$

(ii) $[Rh(NH_3)_6]^{3+}$ and $[Co(NH_3)_6]^{3+}$

(5,4,3,3)

5. (a) Write chemical formulae for the following compounds :

(i) Ammonium tris(oxalato)cobaltate (III)

(ii) Potassium oxidotetrafluoridochromate (V)

(iii) Dichlorido bis(triphenylphosphine) nickel (II)

(iv) Tetrachlorido 1,2-diaminoethane platinum (IV)

(v) Hexaammine cobalt (III) hexacyanidochromate (III)

(b) Draw the structures for the following :

$Fe_2(CO)_9$, $Re_2(CO)_{10}$, $Fe(CO)_5$, $Co_2(CO)_8$

(c) Which of the following are not organometallic compounds and why?

$[K_2Zn(CN)_4]$, $(C_2H_5)_4Pb$, Me_4Sn, $B(OCH_3)_3$

(b) Draw the orbital splitting diagram for tetrahedral $[CoCl_4]^{2-}$ and give its electronic configuration. Calculate its CFSE.

(c) What are homoleptic carbonyls? Give two examples.

(d) The magnetic moment for $[MnBr_4]^{2-}$ and $[Mn(CN)_6]^{3-}$ are 5.9 and 2.8 BM respectively. Give the hybridisation, geometry of each complex on the basis of VBT. (5,4,3,3)

3. (a) On the basis of VBT answer the following questions for the six coordinated complex ion: $[Fe(CN)_6]^{3-}$

(i) What is the oxidation state of Fe?

(ii) What type of hybridization is involved?

(iii) State whether the given complex is inner or outer orbital complex.

P.T.O.

(iv) What is the magnetic behaviour of the complex ion?

(v) Calculate the value of magnetic moment.

(b) CO_2CO_8 (s) shows IR stretching frequencies at two different regions, 2100-2000 cm^{-1} and 1850-1880 cm^{-1}. However, in $Mn_2(CO)_{10}$ all CO stretching frequencies are observed in one region at 2100 cm^{-1}. Predict their structure based on the results of IR data.

(c) Explain the increasing Δ_o values observed in case of the following :

Complex	Δ_o (cm^{-1})
$[Co(NH_3)_6]^{3+}$	23000
$[Rh(NH_3)_6]^{3+}$	34000
$[Ir(NH_3)_6]^{3+}$	41000

(d) What are π-acid ligands? Illustrate with one suitable example. (5,4,3,3)

4. (a) Discuss the structure of the following :

(i) Methyl Lithium

(ii) Ferrocene in solid and gaseous phase

(b) The complex ion $[Ni(H_2O)_6]^{2+}$ is a regular octahedral but $[Cu(H_2O)_6]^{2+}$ is distorted octahedral. Explain why.

(c) Using the 18 electron rule as a guide, identify/ find

(i) The 3d metal in $[\eta^5\text{-}C_5H_5)\ M\ (C_2H_4)_2]$

(ii) The probable number of carbonyl ligands in $[W(\eta^6\text{-}C_6H_6)\ (CO)_n]$.

(iii) The number of Ru-Ru bonds in $[Ru_3(CO)_{12}]$

(d) Which complex in each of the following pairs will have greater crystal field splitting and why

(i) $[Fe(C_2O_4)_3]^{4-}$ and $[Fe(C_2O_4)_3]^{3-}$