

2024/TDC (CBCS)/EVEN/SEM/  
CHMHCC-601T/307

TDC (CBCS) Even Semester Exam., 2024

CHEMISTRY

( 6th Semester )

Course No. : CHMHCC-601T

[ Organometallic Chemistry  
(Inorganic Chemistry) ]

Full Marks : 50

Pass Marks : 20

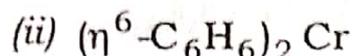
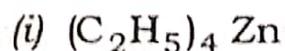
Time : 3 hours

*The figures in the margin indicate full marks  
for the questions*

UNIT—I

1. Answer any *two* questions from the following : 2×2=4

(a) Define organometallic compounds. Identify the nature of metal-ligand bond in the following organometallic compounds : 1+1=2



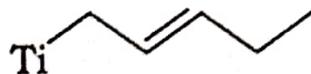
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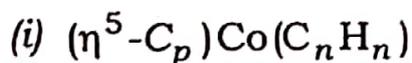
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- (b) What is the hapticity of the ligand in the given complex? Mention the maximum hapticity possible with this ligand :  $1+1=2$



- (c) Using  $18e^-$  rule as guide, determine the values of  $n$  in the following complexes :

$1+1=2$



- (ii)  $[(\eta^5-C_p)Fe(CO)_n]_2$  having one Fe—Fe single bond

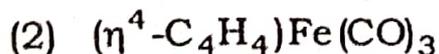
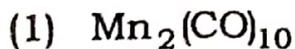
2. Answer any *one* question from the following : 6

- (a) (i) What is meant by  $\pi$ -acidity? 1

- (ii) Is CO a stronger  $\pi$ -acid ligand as compared to  $NO^+$ ? Justify your answer.  $\frac{1}{2}+\frac{1}{2}=1$

- (iii) What is synergic effect? How does it account for the formation of carbonyls with transition metals in low oxidation states?  $1+3=4$

- (b) (i) Draw the structures of the following complexes following EAN rule :  $1 \times 2 = 2$



24J/910

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( 3 )

- (ii) Why is direct nitration of ferrocene not possible? How can you get the nitro derivative of ferrocene? 1+1=2
- (iii) Draw the structures of ferrocene in solid and gaseous states. 2

UNIT—II

3. Answer any two questions from the following : 2×2=4
- (a) Draw the structure of methyl lithium. What are the coordination numbers of Li and C in methyl lithium? 1+1=2
- (b) Write the composition of Ziegler-Natta catalyst. Mention its use. 1+1=2
- (c) Write the synthesis of the cobalt catalyst used in the hydroformylation reaction. 2
4. Answer any one question from the following : 6
- (a) (i) What is Grignard reagent? Why is diethylether an especially good solvent for the preparation of Grignard reagent? 1+2=3
- (ii) What is Schlenk equilibrium? Explain. 2
- (iii) Write the limitations of Grignard reaction. 1

24J/910

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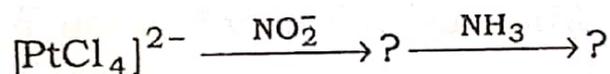
- (b) Both  $\text{AlEt}_3$  and  $\text{AlCl}_3$  dimerize but the nature of alkyl bridging and halide bridging in the dimers are different. Justify.

6

## UNIT—III

5. Answer any two questions from the following :  $2 \times 2 = 4$

- (a) Show the stereochemistry of substitution in the following reaction :



- (b) Define thermodynamic and kinetic stabilities of complexes.

- (c) Define electrophilic substitution reaction in octahedral complexes. Give a suitable example.  $1 + 1 = 2$

6. Answer any one question from the following : 6

- (a) (i) What is *trans*-effect? Explain *trans*-effect in the light of electrostatic polarization theory.  $1 + 3 = 4$

- (ii) What do you mean by aquation and anation reaction in octahedral complexes? Give suitable examples. 2

- (b) Discuss the mechanism of nucleophilic substitution reactions in octahedral complexes and also mention the stereochemistry of the intermediates. 6

UNIT—IV

7. Answer any two questions from the following : 2×2=4

- (a) Draw and explain the structure of Wilkinson catalyst.
- (b) Define oxidative addition reaction. Give example. 1+1=2
- (c) Write the limitations of cobalt catalysts mediated hydroformylation reaction.

8. Answer any one question from the following : 6

- (a) (i) What is synthesis gas? Mention a few sources of synthesis gas. 1+1=2
- (ii) Discuss the mechanistic pathway involved in the production of synthesis gas using metal carbonyl complexes. 4
- (b) (i) What is Fischer-Tropsch process? Mention the catalysts used in this process. 1+1=2
- (ii) Explain the most plausible mechanism for this process. 4

UNIT—V

9. Answer any *two* questions from the following : 2×2=4
- (a) Define common ion effect.
- (b) Write the chemistry of removal of  $\text{BO}_3^{3-}$  from the solution during qualitative analysis of a salt mixture.
- (c) What happens to the solubility of  $\text{Ag}_2\text{CO}_3$  in water on addition of  $\text{AgNO}_3$ ? Explain. 1+1=2
10. Answer any *one* question from the following : 6
- (a) (i) Explain how common ion effect helps in precipitation of Group-III hydroxides. 2
- (ii) When 0.01 M HCl solution is added to a 0.01 M  $\text{Pb}(\text{NO}_3)_2$  solution, will a precipitate of  $\text{PbCl}_2$  be formed or not? Given,  $K_{sp}$  for  $\text{PbCl}_2 = 1.6 \times 10^{-5}$ . 3
- (iii) Mention the group reagents used for analyzing the following cations : 1
- (1)  $\text{Zn}^{2+}$
- (2)  $\text{Mg}^{2+}$

- (b) (i) Explain how a buffer solution  
resists change in pH. 3
- (ii) (1) Write the difference between  
ionic product and solubility  
product. 1
- (2) Discuss the cause of  
interference of some acid  
radicals in inorganic qualitative  
analysis. 2

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