

**G-2/213/21**

Roll No. ....

**M.Sc. II Semester Examination, 2021**

**CHEMISTRY**

Paper I

(Coordination Chemistry)

Time : 3 Hours ]

[ Max. Marks : 80

**Note :** *All questions are compulsory. Question Paper comprises of 3 sections. Section A is objective type/multiple choice questions with no internal choice. Section B is short answer type with internal choice. Section C is long answer type with internal choice.*

**SECTION A**

**1×8=8**

**(One Line Answer Type Questions)**

1. What are dissociative and associative mechanism for legand substitution reaction ?
2. Define effective collision.
3. What are aration reaction ?
4. Nature of bridging group affect the electron transfer reaction, why ?
5. What are vibronic coupling ?
6. Define microstates.
7. What are  $\pi$ -acceptor legands ? Give example.

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8. What are high and low Nuclearity caroxyl cluster ?

**SECTION B**

**4×6=24**

**(Short Answer Type Questions)**

**Note :** Answer the following questions in maximum 250 words.

**Unit-I**

1. (a) What are labile and inert complexes ? Show that lability and inertness of the complexes are different with thermodynamic properties of complexes in solution.  
(b) Illustrate with example Ia and Id process.

Or

- (a) Explain the effect of solvation in equation reacton of  $[\text{Co}(\text{NH}_3)_5\text{X}]^{2+}$  Complex.  
(b) Write mechanism of equation of carbonato complex in which M-L bond is not broken.

**Unit-II**

2. (a) What is law of conservation of energy in electron transfer reaction ? 3  
(b) How will you prepare Cis-trans  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$  starting from  $[\text{PtCl}_4]^{2-}$  ? 3

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Or

- (a) Why dissociative process is preferred in substitution reaction in tetrahedral Complexes ? 3
- (b) What are the conditions for the transfer of an electron from  $M^{2+}$  to  $M^{3+}$  in aqueous medium in context of electron transfer reaction ? 3

### Unit-III

3. (a) Why are d-d electronic transition are forbidden ? Why are they weakly absorbing. 3
- (b) Deduce the term symbol of a  $d^2$  ion. 3

Or

- (a) Define the following : 4
- (i) Lande 'g' factor,
- (ii) Spin only factor.
- (b) How is effective magnetic moment affected by orbital magnetic moment ? 2

### Unit-IV

4. (a) How does IR spectroscopy help in explaining the bonding in metal carbonyl ? 3

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- (b) Write notes on different type bonds in higher boranes. 3

Or

- (a) Write structure of peroxo ( $O_2^{2-}$ ) group containing complex. 3
- (b) Write methods of preparation of Tetraboranes-10 ( $B_4H_{10}$ ). 3

### SECTION C

12×4=48

### (Long Answer Type Questions)

**Note :** Answer all question maximum 500 words.

### Unit-I

1. (a) "Rate constant is measure of collision effectiveness and its magnitude depends upon activation energy and violence in the collision." Discuss the statement in context of reaction kinetics. 7
- (b) Discuss the mechanism of equilibrium reaction of octahedral complexes in which the inert ligand is a  $\pi$  acceptor. 5

Or

- (a) Designate whether the following complexes are labile or inert and give reasons for your choice : 6

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- (i)  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  (ii)  $[\text{Co}(\text{NO}_2)_6]^{3-}$   
 (iii)  $[\text{PtCl}_6]^{2-}$  (iv)  $[\text{Ca}(\text{C}_2\text{O}_4)_3]^{3-}$   
 (v)  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  (vi)  $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$

- (b) Base hydrolysis of  $[\text{Ca}(\text{NH}_3)_5\text{Cl}]^{2+}$  is apparently  $\text{SN}^2$  process, but is infact, yet another type of  $\text{SN}^1$  process. Explain and show the evidences in favour of that mechanism. 6

### Unit-II

2. (a) Discuss the rate law for substitution reaction in square planar complexes. 4  
 (b) What are the main characteristics of electron transfer reaction occurring through inner-sphere mechanism. 4  
 (c) Write simplified Marcus-equation. 4

Or

- (a) Discuss polarisation theory of trans-effect. 3  
 (b) Explain why ? 6  
 (i) The transfer of electron from  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  to  $[\text{Co}(\text{NH}_3)_6]^{3+}$  in aqueous

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medium is slower than the transfer from  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  to  $[\text{Co}(\text{NH}_3)_5\text{OH}]^{2+}$ .

- (ii) The transfer of electron from  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  to  $[\text{Cr}(\text{NH}_3)_5\text{NCS}]^{2+}$  is slower than the transfer from  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  to  $[\text{Cr}(\text{NH}_3)_5\text{N}_3]^{2+}$ .

- (c) Define cross reaction with one example. 3

### Unit-III

3. (a) Draw Orgel energy level diagram of  $d^2$  configuration. Write energy terms of  $[\text{V}(\text{H}_2\text{O})_6]^{3+}$ . Why does its electronic spectrum have only two bands. 4  
 (b) What is nephelauxetic series ? How can you calculate Racah parameter  $\beta$  from spectral value ? Explain 'g' and 'f' factor. 4  
 (c) What is anomalous magnetic moment ? Give one explanation to account for it. 4

Or

- (a) When visible light is passed through a solution of Ni(II) sulphate, a green solution results. How does the spin allowed

transitions responsible for this colour ?

Would you expect a Jahn-Teller distortion for this complex ? 5

(b) Discuss the effect of temperature on the corrected values of magnetic susceptibility of paramagnetic substances. Describe two laws that governs the effect of temperature. 4

(c) What are LMCT-transition ? Explain the colour of  $\text{MnO}_4^-$  Ion.

#### Unit-IV

4. (a) Taking example of  $\text{Ni(CO)}_4$  discuss bonding in mononuclear carbonyl. Show that  $\text{Ni(CO)}_4$  obeys 18 electron rule and give an example of metal carbonyl/which does not obey this rule. 6

(b) Discuss structure of  $\text{Co}_2(\text{CO})_8$  in solid state by valence bond theory. 3

(c) What is the importance of dioxygen ligand in human life ? 3

Or

(a) Highlight the Co-ordination chemistry of dinitrogen complexes with special reference to their preparation and back bonding. 6

(b) Write short notes on the following : 6

(i) Isoelectronic relationship,

(ii) Isolobal relationship,

(iii) Quadrupole bond.

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