2023

M.Sc.

First Semester

CORE – 01

CHEMISTRY

Course Code: MCHC 1.11

(Inorganic Chemistry - I)

Total Mark: 70 *Pass Mark: 28*

Time: 3 hours

Answer five questions, taking one from each unit.

UNIT–I

1. (a) What is symmetry elements? Discuss the symmetry elements present in water molecule with suitable diagrams. 1+4=5
   (b) Explain with examples how you would differentiate between $C_{\infty v}$ and $D_{\infty v}$. 2+2=4
   (c) Give the multiplication table of point group C_{3v} and mention whether it is abelian or non-abelian. 5

2. (a) Systemmatically explain the symmetry elements and operations present in tetrahedral geometry with the help of diagrams. 5
   (b) Draw the structures of the following coordination compounds and assign their point group: 2+2=4
   (i) $[Fe(CO)_5]$ (ii) $[TaF_8]$
   (c) What are reducible and irreducible representations? Discuss how to carry out similarly transformation of the diagonal elements to form block factorised. 5

UNIT–II

3. (a) Draw the molecular orbital diagram for NO^- anion and mention the magnetic character. 4
   (b) What are the factors affecting stability of metal complexes? 4

(c) Write short notes on the following: 3×2=6
(i) Walsh diagram
(ii) Polarity of bonds

4. (a) Draw the molecular orbital diagram for NO^+ cation and mention the magnetic character. 4
(b) What do you mean by chelate effect? Discuss the trends in stepwise formation constants. 1+3=4
(c) Write short notes on the following: 3+3=6
(i) Dipole moment
(ii) Inner and outer orbital complexes.

UNIT–III

5. (a) What are microstates? Calculate the total number of microstates for electronic configuration
(i) d^4 (ii) p^2 1+1½+1½=4
(b) Find out the possible term symbol of electronic configuration: 3×2=6
(i) d^7 (ii) d^3
(c) Write short notes on the following: 2×2=4
(i) Diamagnetism (ii) Paramagnetism

6. (a) Explain the determination of magnetic susceptibility using Gouy's method. Give its advantages and disadvantages. 3+2+2=7
(b) Discuss temperature independent paramagnetism. 3
(c) Find out the ground state term for Ni^{2+}. 4

UNIT–IV

7. (a) Determine the magnetic nature of the following by applying CFT:
(i) $[CoF_6]^{3-}$ (ii) $[Co(CN)_6]^{3-}$ 1½+1½=3
(b) Explain the below complexes as having no, weak and strong Jahn Teller distortion : 2×3=6
(i) $[Fe(CN)_6]^{4-}$ (ii) $[Fe(CN)_6]^{3-}$
(iii) $[CrF_6]^{4-}$

(c) What is spin cross over? Mention the conditions required to have spin cross over. 2

(d) Calculate CFSE of the following:

(i) Mn^{2+} (octahedral LS)

(ii) Cr^{2+} (octahedral HS) 1½+1½=3

8. (a) Calculate g (gyromagnetic ratio) of the following: 3×2=6

(i) $Er^{3+}(Z = 68)$ (ii) $Pm^{3+}(Z = 61)$

(b) Name two lanthanide metal ions showing high magnetic moment values. 2

(c) Compare octahedral and tetrahedral complexes by taking their CFSE values and plot a graph. 6

UNIT–V

9. (a) Write down the split states of an octahedral and tetrahedral field of S, P, D and F free ion state. 4

(b) What are Orgel diagrams? Draw the Orgel diagram for a d^2 and d^7 metal ion in an octahedtral field and mention the expected bands. 2+5=7

(c) What is nephelauxetic series? 3

10. (a) What is adjusted crystal field theory? Discuss the evidences showing presence of covalent bonding in complexes. 2+5=7

(b) Three bands are expected in an octahedral $[V(H_2O)_6]^{3+}$ complex but only two bands are observed. Give reasons. 4

(c) Give reasons why transitions are forbidden in octahedral d^5 complexes. 3