

November 2025
M.Sc.
First Semester
CORE – 01
CHEMISTRY
Course Code: MCHC 1.11
(Inorganic Chemistry - I)

Total Mark: 70
Time: 3 hours

Pass Mark: 28

Answer five questions, taking one from each unit.

UNIT-I

1. (a) Explain the following with one example each: 2×2=4
 - (i) Proper rotation
 - (ii) Inversion centre
- (b) Systematically explain the symmetry elements and operations present in octahedral geometry. 5
- (c) Give the multiplication table of the point group C_{3v} and determine whether it is an abelian or non-abelian group. 5

2. (a) What is a point group? Differentiate between $C_{\infty v}$ and $D_{\infty v}$ with suitable examples. 1+4=5
- (b) Draw the structure of the following coordination compounds and write the point group: 4
 - (i) $[\text{Ni}(\text{CN})_4]^{2-}$
 - (ii) $[\text{NbOF}_6]^{3-}$
 - (iii) $[\text{TaF}_8]^{3-}$
 - (iv) $[\text{Co}(\text{NH}_3)_6]^{2-}$
- (c) What are reducible and irreducible representations? Explain the similarity transformation of the diagonal elements to form block factorised. 1+4=5

UNIT-II

3. (a) Write short notes on the following: 2×3=6
 - (i) Inner and outer orbital complexes
 - (ii) Polarity of bonds
 - (iii) Allred-Rochow method of electronegativity

- (b) What do you mean by chelate effect? Discuss the trends in stepwise formation constants. 1+3=4
- (c) Draw the molecular orbital energy level diagram of NO molecule. Calculate the bond order and mention the magnetic character. 4
4. (a) Write short notes on the following: 2×3=6
- (i) Dipole moment
 - (ii) Walsh diagram
 - (iii) Linear combination of atomic orbital (LCAO)
- (b) What are the factors affecting the stability of metal complexes? 4
- (c) Draw the molecular orbital energy level diagram of O₂ molecule. Calculate the bond order and mention the magnetic character. 4

UNIT-III

5. (a) Find out term symbols of the following: 3½×2=7
- (i) V³⁺
 - (ii) Mn²⁺
- (b) How would you determine magnetic susceptibility using Faraday's method? Mention its advantages and disadvantages. 4+3=7
6. (a) Write short notes on the following: 3×2=6
- (i) Ferromagnetism
 - (ii) Ferrimagnetism
- (b) Calculate total number of microstates in p² and d¹. 1½+1½=3
- (c) Explain quenching of orbital angular momenta of octahedral complexes. 5

UNIT-IV

7. (a) Explain the following metal ions as having weak or strong JTD: 2×3=6
- (i) Cu²⁺ (Oh and strong field)
 - (ii) Fe²⁺ (Oh and weak field)
 - (iii) Cr²⁺ (Oh and weak field)

- (b) Calculate CFSE of the following: 2×3=6
- (i) Fe^{3+} (Oh and LS)
- (ii) Cr^{2+} (Td and HS)
- (iii) Co^{2+} (Oh and LS)
- (c) Give two main postulates of CFT. 2
8. (a) Calculate the magnetic moment of the following lanthanide ions: 4×2=8
- (i) Nd^{3+} (At. no = 60)
- (ii) Ce^{3+} (At. no = 58)
- (b) Compare octahedral and tetrahedral complexes by taking CFSE and plot a graph. 6

UNIT-V

9. (a) What are the expected transitions in a weak field octahedral d^8 ion? Mention the ground state and excited states. 4
- (b) The aqueous solution of $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ is pale green in colour. Draw the Orgel diagram representation and mention its absorption spectrum. 4
- (c) What is adjusted crystal field theory? Discuss anyone of the evidence showing presence of covalent bonding in complexes. 2+4=6
10. (a) Discuss molecular orbital diagram of complexes with ligand having vacant orbitals for pi-bonding. 6
- (b) Write notes on spectrochemical series. 3
- (c) Discuss some of the optical properties of lanthanides. 5