2022
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 <u>five</u> *questions, taking* <u>one</u> *from each unit.*

UNIT–I

1. (a) Define symmetry elements and symmetry operations. Discuss the different types of plane of symmetry (σ) with suitable example.
                                                                    1+3=4

    (b) Assign the following molecule to their respective point groups.
         (i) H_2O_2 (ii) NH_3 ½×6=3
         (iii) XeF_4 (iv) $[Co(en)_3]^{3+}$
         (v) CO_2 (vi) PCl_5

    (c) What is a matrix? Discuss the matrix representation of point group C_{2V}.   1+6=7

2. (a) Give one example each to the following point group by writing their symmetry elements.   1½×2=3
         (i) C_{3V} (ii) D_{4d}

    (b) What do you mean by point group? Systematically discuss the symmetry elements and operations present in octahedral geometry with the help of suitable diagrams.   1+6=7

    (c) Explain the rules which any set of elements or symmetry operations must obey to constitute a group.   4

UNIT–II

3. (a) Draw the MO energy level diagram for CO and mention the magnetic character.   4

(b) Write short notes on the following: 3×2=6
   (i) Allred-Rochow method of electronegativity
   (ii) Orbital symmetry
(c) Explain the stepwise and overall formation constants. 4

4. (a) Write short notes on the following: 3×2=6
   (i) Overlap of atomic orbitals
   (ii) Linear combination of atomic orbitals
(b) Draw the MO energy level diagram for CN and mention the magnetic character. 4
(c) Explain the determination of binary formation constant by spectrophotometry. 4

UNIT–III

5. (a) Briefly explain the determination of magnetic susceptibility using Faraday's method. Give its advantages. 4+2=6
(b) Write notes on ferrimagnetism and anti-ferrimagnetism. 2+2=4
(c) Discuss the quenching of orbital angular momentum in octahedral complexes. 4

6. (a) Derive Currie's law equation. 3
(b) What is diamagnetism? What is the difference between diamagnetic value and corrected diamagnetic value? 1+3=4
(c) Powdered $(NH_4)_2Co(SO_4)_2.6H_2O$ has $\chi = 6.70\times10^{-4}$ at 293K. Given that the density $= 1.92\times10^3$ kgm^{-3}. Calculate diamagnetic correction and the effective magnetic susceptibility. 4
(d) Explain the relationship between magnetic susceptibility and magnetic moment for a paramagnetic substance. 3

UNIT–IV

7. (a) Explain crystal field splitting of d-orbitals in octahedral complexes with neat diagrams. 4
(b) Find out magnetic properties of the following on the basis of CFT.
   (i) $[Mn(H_2O)_6]^{2+}$ (ii) $[Co(NH_3)_6]^{+3}$ 2×3=6
   (iii) $[FeF_6]^{-3}$
(c) Which metal ion/ions show John Teller distortion?

(i) Fe^{+3} (low spin)   (ii) Mn^{+3} (high spin)

If yes, mention if it is strong or weak JTD.   2+2=4

8. (a) Calculate magnetic moment of the following: 4×2=8
   (i) Ce^{+3} (at.no. 58)
   (ii) Nd^{+3} (at.no. 60)
   (b) Calculate CFSE of the following: 2×3=6
   (i) d^5 (octahedral low spin)
   (ii) d^7 (octahedral high spin)
   (iii) d^4 (tetrahedral high spin)

UNIT–V

9. (a) What are Tanabe-Sugano diagrams? Draw the Tanabe-Sugano diagram for a d^1 metal ion and calculate its Dq value.   2+4=6
   (b) Explain the molecular orbital theory of octahedral complexes with π-bonding.   4
   (c) How many transitions do we observe in $[Cr(H_2O)_6]^{+3}$ complex? Mention the spin forbidden transition that occurs at 15,000 cm^{-1}.
        2+2=4

10. (a) Draw Orgel diagram for a d^6 metal ion in a tetrahedral ligand environment.   4
    (b) Discuss the electronic absorption spectra if a high spin $[X(H_2O)_6]^{+3}$ complex. How many bonds are observed in the complex?   3+1=4
    (c) Write short notes on the following: 2×3=6
    (i) Spectrochemical series
    (ii) Band intensities
    (iii) Band widths

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