2022

B.A./B.Sc.

Third Semester

GENERIC ELECTIVE – 3

CHEMISTRY

Course Code: CHG 3.11

(Chemical Bonding, Transition Metals & Coordination Chemistry)

Total Mark: 70 *Pass Mark: 28*

Time: 3 hours

Answer five *questions, taking* one *from each unit.*

UNIT–I

1. (a) Write notes on equivalent and non-equivalent hybrid orbitals with an example each. 4
   (b) Define resonance. Give the resonance structures of O_3 and NO_3^-. 1+1½+1½ = 4
   (c) Using VSEPR theory, predict the hybridisation and geometry of PCl_5, SO_4^{2-} and SF_6. 2×3=6

2. (a) What is hybridisation? Discuss sp hybridisation with an example. 1+2=3
   (b) Beryllium (Z = 4) has no unpaired electron in its ground state. However, in all its compounds it shows divalent. Explain. 3
   (c) Write any two postulates each of valence bond theory and VSEPR theory. 2×2=4
   (d) Draw the shape of H_2O, NH_3 and CH_4 molecules according to VSEPR theory and give reasons why they have different bond angles even though all of them shows sp^3 hybridisation. 4

UNIT–II

3. (a) Discuss the linear combination of atomic orbitals (LCAO) method. 4
   (b) Write the MO configuration of F_2 molecule. Determine the bond order, magnetic behaviour and draw the MO energy level diagram. 1+1+1+2 =5

(c) Write notes on the following: 2½×2 = 5
(i) Van der Waals forces
(ii) Effects of hydrogen bonds in boiling point, melting point, and solubility.

4. (a) With pictorial representation, explain the formation of bonding and antibonding molecular orbitals by the combination of: 2½×2=5
(i) s and p_x orbitals and
(ii) two p_x orbitals
(b) Write the MO electronic configuration of B_2 and N_2 molecules. Calculate their bond order and mention which one should be more stable. 5
(c) What are the main postulates of molecular orbital theory? 4

UNIT–III

5. (a) Write the electronic configuration of the following: 1×4=4
(i) Cr (Z = 24) (ii) Cu (Z = 29)
(iii) Gd (Z = 64) (iv) Ac (Z = 89)
(Z= atomic number)
(b) What is lanthanoid contraction? Discuss the separation of lanthanoids contraction by ion exchange method. 1+4=5
(c) Explain the Latimer diagram for Mn and Cu. 2½×2=5

6. (a) Discuss the magnetic properties of the first transition series with examples. 4
(b) Most of the transition elements in their compounds show colouration. Comment. 4
(c) Compare the oxidation states and magnetic properties of lanthanoids with actinoids. 3×2 =6

UNIT–IV

7. (a) Give the postulates of VBT and its limitations. 4+2=6
(b) Write short notes on the following with an example each: 2×2=4
(i) Linkage isomerism
(ii) Hydrate isomerism

(c) Give the IUPAC name of the following coordination compounds:
(i) $[Cu(NH_3)_4]SO_4$ (ii) $K_3[Fe(CN)_6]$ 1×4 =4
(iii) $[Cr(H_2O)_6]Cl_3$ (iv) $Na_2[Zn(CN)_4]$

8. (a) Find out the magnetic nature of the following by applying VBT and draw their structures: 2×3=6
(i) $[FeF_6]^-$ (ii) $[Ni(CN)_4]^{2-}$
(iii) $[NiCl_4]^{2-}$
(b) Discuss the geometrical isomerism in complexes of coordination number 4. 4
(c) Discuss with an example each about inner and outer orbital complexes. 4

UNIT–V

9. (a) Give the postulates of crystal field theory. 3
(b) Giving a neat diagram, explain how the d-orbitals split when metal ion is placed in the centre of a tetrahedral field. 5
(c) Determine the magnetic character of the following complex ions by applying CFT: 2×3=6
(i) $[Co(NH_3)_6]^{3+}$ (ii) $[Fe(H_2O)_6]^{2+}$
(iii) $[Fe(CN)_6]^{4-}$

10. (a) What is CFSE? Calculate the CFSE of the following: 1+2×4=9
(i) d^5 (low spin octahedral)
(ii) d^5 (high spin octahedral)
(iii) d^6 (low spin octahedral)
(iv) d^7 (high spin octahedral)
(b) Give two factors affecting the magnitude of crystal field splitting. 1½×2=3
(c) Which one has stronger Jahn-Teller distortion? Give reason. $[Cu(H_2O)_6]^{2+}$ or $[Ti(H_2O)_6]^{3+}$. 2
