2023

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) What are the main postulates of valence bond theory? 4
   (b) Give the resonance structures of SO_4^{2-} and CO_3^{-2} ions. 1½×2=3
   (c) What is sp^2 type of hybridization? Discuss it with an example. 1+2=3
   (d) Write short notes on the following: 2×2=4
      (i) s-s overlapping
      (ii) Resonance energy

2. (a) What are the main postulates of VSEPR theory? 4
   (b) Draw the resonance structures of ClO_4^- and SO_3. 1½×2=3
   (c) Discuss the rules of hybridization. 3
   (d) Write short notes on the following: 2×2=4
      (i) Head to head overlapping
      (ii) Sidewise overlapping

UNIT–II

3. (a) With pictorial representation explain the formation of bonding and anti-bonding molecular orbitals by the combination of: 2½×2=5
      (i) Two p_y atomic orbitals
      (ii) s and p_x orbitals

(b) Write the MO configuration of CO molecule. Calculate its the bond order and draw its MO energy level diagram. 1+1+3 =5

(c) What is hydrogen bonding? Classify it with two examples each. 1+3=4

4. (a) Discuss the constructive and destructive interference of electron waves in the formation of bonding and anti-bonding orbitals. 4

(b) Write the MO electronic configuration of O_2^- ion. Calculate the bond order and draw its MO energy level diagram. 1+1+3=5

(c) What is bond order? Discuss how it affects the stability of ions and molecules with suitable examples. 1+4=5

UNIT–III

5. (a) Discuss the exceptional electronic configuration of Cr and Cu. 4

(b) Explain the various oxidation states exhibited by the 3d transition series and its relative stability. 5

(c) What are Latimer diagram? Explain the Latimer diagram for Fe. 2+3=5

6. (a) Explain the magnetic properties of 3d transition series. 5

(b) What are lanthanoids? Mention the uses of cation exchanger and anion exchanger. 2+3=5

(c) Write the electronic configuration of thorium (atomic number = 90) and uranium (atomic number = 92). 2+2=4

UNIT–IV

7. (a) Define geometrical isomerism. Discuss geometrical isomerism in complexes of coordination number six. 1+5=6

(b) Give the IUPAC name of the following: 1×5=5

(i) $[Mn(NH_3)_3(H_2O)_3]Cl_2$

(ii) $Na[Au(CN)_2]$

(iii) $K_4[Mo(CN)_8]$

(iv) $[Co(NH_3)_6]Cl_3$

(v) $Na_3[Co(NO_2)_6$

(c) How many isomers are produced for the square planar complex of the type Mabcd (M = metal)? Draw the possible square planar isomers. 1+2=3

8. (a) Explain ionisation and coordination isomerism with examples. 2+2=4

(b) Find out the magnetic character of the following by applying VBT and draw their structure. 2×3=6

(i) $[Ni(CO)_4]$

(ii) $[Fe(CN)_6]^{-3}$

(iii) $[CoF_6]^{-3}$

(c) What is stereoisomerism? Discuss stereoisomerism of the complexes of the type $[M(aa)_3]$ (where, aa = bidentate ligand). 1+3= 4

UNIT–V

9. (a) State Jahn Teller distortion. Which of the following complex ions have no weak and strong Jahn Teller distortion? 1+2×3=7

(i) $[CoF_6]^{-3}$

(ii) $[Fe(CN)_6]^{-4}$

(iii) $[Cr(H_2O)_6]^{+2}$

(b) Compare octahedral and tetrahedral complexes by taking their CFSE values and plot a graph. 7

(i) $[Co(NH_3)_6]^{3+}$

(ii) $[Fe(H_2O)_6]^{2+}$

(iii) $[Fe(CN)_6]^{4-}$

10. (a) Explain crystal field splitting of d-orbitals of octahedral complexes with neat diagrams. 5

(b) Find out the magnetic character of the following: 2×3=6

(i) $[FeF_6]^{-3}$

(ii) $[Mn(H_2O)_6]^{+3}$

(iii) $[Co(CN)_6]^{-3}$

(c) Calculate CFSE of 1½+1½=3

(i) d^4 (octahedral LS)

(ii) d^6 (tetrahedral).