

10. (a) Discuss, with illustration. the active site structure and subunit arrangement of non-heme iron protein, ferritin. State its role in the biological system. 4+2=6
- (b) Discuss the 'trigger effect' in hemoglobin. 4
- (c) Furnish an account of the active site structure of cytochrome C protein and its function in biological system. 3+1=4

PG Even Semester Examination, May 2025

CHEMISTRY

(2nd Semester)

Course No.: CHM-551
(Inorganic Chemistry-II)

Full Marks: 70

Pass Marks: 28

Time: 3 hours

*The figures in the right margin indicate full marks for the question.
Answer any five questions selecting one from each unit.*

UNIT-I

1. (a) Define ferromagnetism and antiferromagnetism and explain the variation of molar susceptibility (c) *versus* temperature (T) for ferro- and antiferromagnetic materials. 2+2 = 4
- (b) Briefly discuss orbital contribution to the magnetic moment and quenching of orbital angular moment. 4
- (c) Write down the Van Vleck magnetic susceptibility equations and explain the normal and temperature independent paramagnetism. 4
- (d) Explain the temperature dependence of second order magnetic susceptibility. 2
2. (a) Deduce the relation between magnetic permeability and magnetic susceptibility

by using the Gauss's law. How permeability varied for diamagnetic and paramagnetic substances? 3

- (b) Find out the ground state RS term symbol for d^3 configuration. Show the splitting of d^3 ion RS term in weak octahedral crystal field. 1+3=4
- (c) Explain canting phenomena. When hidden and overt canting observed? Give examples. 3
- (d) What do you mean by multiplet and multiplet width? How magnetic moment will be calculated when multiplet width (ΔE) is large as compared to kT ? 4

UNIT-II

3. (a) Write down the selection rules for electronic transitions. d-d transitions are Laporte forbidden, yet they give colour. Explain. 2+2=4
- (b) Prove that the transition moment integral, $|m|$ has finite value for d-d transition. 4
- (c) UV-Vis spectral bands in MnO_4^{4-} are more intense than in $[Mn(H_2O)_6]^{2+}$. Explain. 3
- (d) What is Nephelauxetic effect? Briefly discuss. 3
4. (a) Draw the Orgel diagram of $[Cr(H_2O)_6]^{3+}$ and deduce the Racah parameter (B) and Nephelauxetic parameter (β) from the observed transition values 17400 cm^{-1} , 24600 cm^{-1} and 37800 cm^{-1} , where B_0 for free Cr^{3+} ion is 918 cm^{-1} . 3+3=6

- (d) "The pK_a values of the hydride $[CoH(CO)_4]$ and $[CoH(CO)_3PPh_3]$ in acetonitrile at $25^\circ C$ is 8.3 and 15.4" Explain. 1.5
8. (a) In linear metal nitrosyls NO is a three electron donor, whereas in bent nitrosyls, NO is one electron donor" Justify the statement with examples. 3
- (b) Propose a set of reactions for the formation of $[W(C(OCH_3)Ph)(CO)_5]$ starting with hexacarbonyltungsten(0) and other reagent of your choice. 4
- (c) Apply the electron counting schemes and the capping rule to obtain the structures of $[Os_8(CO)_{22}]^{2-}$ and $[Os_{10}C(CO)_{24}]^{2-}$ 4
- (d) Which metal carbonyl in each (i) $[Fe(CO)_4]^{2-}$ or $[Co(CO)_4]^-$ and (ii) $[Mn(CO)_5]^-$ or $[Re(CO)_5]^-$ should be most basic towards a proton? Justify. 3

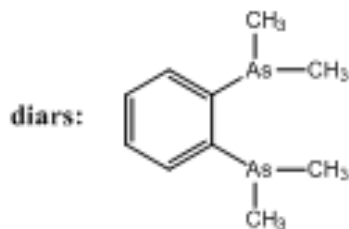
UNIT-V

9. (a) Discuss the role and active site structure of $[Fe_2S_2]$ Riske type ferredoxin. State the possible oxidation levels and their magnetic behaviour. 3+3=6
- (b) Discuss, with illustration, the dioxygen binding ability of myoglobin and hemoglobin. In this context, explain how dioxygen delivery in tissues is facilitated. 3+2=5
- (c) Discuss the role and active site structure of oxyhemocyanin and comment on the magnetic behaviour of hemocyanin and oxyhemocyanin. 3

- (b) Describe the separation of lanthanides using valence change method and ion exchange method. 2+3=5
- (c) Why lanthanide ions show sharp intense absorption? Illustrate the luminescence spectra of a lanthanide complex. 1+2=3
- (d) Describe the application of lanthanides in NMR shift reagent taking suitable example. 3

UNIT-IV

7. (a) Suggest point group for the complex $M(CO)_5L$, $trans-M(CO)_4L_2$ and $cis-M(CO)_4L_2$. How many $\nu(CO)$ stretching bands do you expect for each compound? Rationalize your answer. 4
- (b) Complete the following reaction : 4.5
- i) $3[Co_2(CO)_8] + 12 py \longrightarrow$
- ii) $Ru_2(O_2CCH_3)_4Cl + CO (70 atm) \longrightarrow$
- iii) $RhNO(PPh_3)_3 + CoCl(PPh_3)_3 \rightleftharpoons$
- (c) "Reaction of $[Co(diars)_2(NO)]^{2+}$ with SCN^- ion changes the bonding pattern of nitrosyl from linear to bent" Explain 4



- (b) Explain LMCT, MLCT, LLCT and MMCT transitions with suitable examples. 4
- (c) $[V(H_2O)_6]^{3+}$ shows only two peaks instead of three in UV-visible spectroscopy. Explain. 4

UNIT-III

5. (a) Explain the relative stabilisation of oxidation states of Co^{3+}/Co^{2+} redox couple in aqueous solution with varying ligands (viz., H_2O , $E^0 = +1.84V$; NH_3 , $E^0 = -0.10V$ and CN^- , $E^0 = -1.0V$). How their redox properties changes? 2+1=3
- (b) Write factors responsible to achieve (i) higher and (ii) lower coordination numbers in 2nd and 3rd row transition metals. 1+1=2
- (c) Draw the structure and describe the classical and non-classical dihydrogen bonding in $Fe(PR_3)_3H_4$ and $Os(PR_3)_3H_4$ respectively. 3
- (d) ' $TiCl_2$ is strongly reducing but CuO_2^- is strongly oxidising'. Explain. 5
- (e) Furnish the synthesis of following compounds and sketch their solid-state structures.
- (i) $Ti(OC_2H_5)_4$ (ii) VF_5 (iii) $Cr(\eta^2-O_2)_2Py$ 4.5
6. (a) Why Praseodymium shows anomaly in electronic configuration with $[Xe]4f^36s^2$ instead of $[Xe] 4f^25d^16s^2$? Explain why Promethium is radioactive. 1+2=3