magnetic behaviour of hemocyanin and oxyhemocyanin. 3

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

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# PG Even Semester Examination, May 2025

## CHEMISTRY

(2nd Semester)

Course No.: CHMCC-201

**(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 mola susceptibility ($\chi$) *versus* temperature (T) for ferro- and antiferro-magnetic 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 ($\Delta E$) 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 $MnO^{4-}$ 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 ($\beta$) 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°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 [Fe2S2] Reiske 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

6. (a) Why Praseodymiun shows anomaly in electronic configuration with $[Xe]4f^3 6s^2$ instead of $[Xe]\ 4f^2 5d^1 6s^2$? Explain why Promethium is radioactive. 1+2=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 $\upsilon(CO)$ stretching bands do you expect for each compound? Rationalize your answer. 4

(b) Complete the following reaction : 4.5

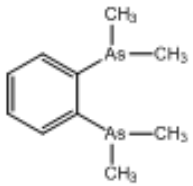
i) $3\left[Co_2(CO)_8\right] + 12\ py \longrightarrow$

ii) $Ru_2\ (O_2CCH_3)_4\ Cl + CO\ (70\ atm) \longrightarrow$

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

diars:






(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; NH3, $E^0$ = -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. 4.5

(i) $Ti(OC_2H_5)_4$ (ii) $VF_5$ (iii) $Cr(ç^2\text{-}O_2)_2Py$