UNIT-I
Structure & Bonding: Applications of VSEPR, Valence Bond and Molecular orbital theories in explaining the structures of simple molecules- role of p and d orbitals in pi bonding.
Application of MO theory to square planar \((\text{PtCl}_4^{2-})\) and Octahedral complexes \((\text{CoF}_6^{3-}, \text{Co(NH}_3)_6^{3+})\).
Walsh diagram for \(\text{H}_2\text{O}\) molecule.

UNIT-II
Inorganic cage and ring compounds – preparation, structure and reactions of boranes, carboranes, metallacarboranes, boron–nitrogen \((\text{H}_3\text{B}_3\text{N}_3\text{H}_3)\), phosphorus–nitrogen \((\text{N}_3\text{P}_3\text{Cl}_6)\) and sulphur–nitrogen \((\text{S}_4\text{N}_4, (\text{SN})_x)\) cyclic compounds.
Isopoly and heteropoly acids.

UNIT-III
Coordination compounds: Crystal field theory - crystal field splitting patterns in octahedral, tetrahedral, tetragonal, square planar, square pyramidal and trigonal bipyramidal geometries. Calculation of crystal field stabilization energies. Factors affecting crystal field splitting energies – Spectrochemical series – Jahn – Teller effect, nephelauxetic effect – ligand field theory.


UNIT- IV
Electronic spectra of transition metal complexes: Selection rules, break down of selection rules – Orgel and Tanabe-Sugano diagrams for \(d^1 - d^9\) octahedral and tetrahedral transition metal complexes of 3d series – Calculation of \(D_Q, B\) and \(\beta\) parameters. Charge transfer spectra.

Text books:
DEPARTMENT OF INORGANIC AND ANALYTICAL CHEMISTRY
MODEL QUESTION PAPER
M.Sc. Previous Chemistry Syllabus  Semester I
Paper- II: Inorganic Chemistry-I
(Effective from 2011-2012 admitted batch)

Time: 3 hours          Max. Marks: 80

SECTION-A
ANSWER ALL QUESTIONS                                4x5=20 Marks

1. a) Predict the geometries of ClF₃, XeF₄ and SF₄ molecules using VSEPR theory.
Or
   b) Draw the Walsh diagram for H₂O molecule and predict its structure.

2. a) Discuss the structure and properties of borazole.
Or
   b) Write a short note on homopoly and heteropoly acids.

3. a) Draw and explain the crystal field splitting of ‘d’ orbitals in square planar and
     trigonal bipyramidal geometries.
Or
   b) Write a note on nephelauxetic effect.

4. a) Draw the Orgel diagram for \([\text{TiCl}_4]^-\) ion and explain the electronic transitions.
Or
   b) Calculate the spin only magnetic moments of the following ions:
      (i) \([\text{MnCl}_6]^{3-}\)     (ii) \([\text{Fe(CN)}_6]^{3-}\)

SECTION-B
ANSWER ALL QUESTIONS                              4x15=60 Marks

5. a) What is LCAO method? Predict bond order and bond lengths in O₂⁺ and O₂⁻ ions based on
     MO energy level diagram.
Or
   b) Draw the MO energy level diagram for \([\text{Co(NH}_3)_6]^{3+}\) and discuss its magnetic properties.

6. a) Discuss the preparation of, structure of, and bonding in N₃P₃Cl₆.
Or
   b) Explain the method of counting skeletal electrons in cluster compounds.

7. a) Discuss the factors affecting crystal field splitting energies.
Or
   (b) (i) Write an account on Russell – Saunders coupling.
       (ii) Derive the term symbols for \(\text{Ni}^{2+}\) and identify the ground state term symbol.

     diagram for \([\text{V(H}_2\text{O})_6]^{3+}\) and explain the electronic transitions.
Or
   (b) Discuss different types of paramagnetic behaviour of transition metal complexes.
UNIT-I
Metal cluster compounds - definition – evidences for existence of M-M bonds - conditions favorable for formation of M-M bonds – preparation, structure and bonding of the following metal cluster compounds.

\[
\begin{align*}
&\text{Re}_2\text{Cl}_8^{2-}, \text{Mo}_2\text{Cl}_8^{4-}, \text{Re}_2(\text{RCOO})_8\text{X}_2, \text{Mo}_2(\text{RCOO})_8(\text{H}_2\text{O})_2, \text{Cr}_2(\text{RCOO})_8(\text{H}_2\text{O})_2, \text{Cu}_2(\text{RCOO})_8(\text{H}_2\text{O})_2, \text{Cr}_2\text{Cl}_9^{3-}, \text{Mo}_2\text{Cl}_9^{3-}, \text{W}_2\text{Cl}_9^{3-}, \text{Re}_3\text{Cl}_9, \text{Re}_3\text{Cl}_{12}^{3+}, \text{Mo}_6\text{Cl}_8^{4+}, \text{Nb}_6\text{X}_{12}^{2+} \text{and Ta}_6\text{X}_{12}^{2+}.
\end{align*}
\]

Polyatomic clusters – Zintl ions, Chevrel phases.

UNIT-II
Organometallic compounds - 16 and 18 electron rules.


Isolobal relationship – H, Cl, CH₃, Mn(CO)₅; S, CH₂, Fe(CO)₅; P, CH, Co(CO)₃

Synthesis, structure, bonding and reactions of metallocenes with special reference to ferrocene

UNIT-III
Metal Ligand equilibria in solution:


Reactivity of metal complexes – inert and labile complexes. Explanation of lability on the basis of valence bond and crystal field theories.

UNIT-IV
Inorganic Reaction Mechanisms:


Electron transfer reactions of complexes – concept of complementary and non-complementary reactions with examples. Inner and outer sphere mechanisms.

Text books:

1. a) Discuss the structure and magnetic property of Cu₂(RCOO)₄(H₂O)₂.
   Or
   b) Write a note on Chevrel phases.

2. a) Explain Isolobal relationship with suitable examples.
   Or
   b) What is 18 electron rule? Illustrate with suitable examples.

3. (a) Describe the pH – metric method for the determination of stability constants.
   Or
   (b) What are inert and labile complexes? How are they explained by using crystal field stabilization energies?

4. (a) What is trans effect? Distinguish between the trans effect and trans influence.
   Or
   (b) What are anation reactions? Discuss the mechanism of anation reactions.

5. a) Discuss the preparation of, structures of and bonding in Re₂Cl₈²⁻.
   OR
   b) Describe the structures of hexanuclear metal clusters.

6. a) Explain the synthesis, structure and reactions of metal carbonyls.
   OR
   b) Describe the preparation of, structure of and bonding in ferrocene.

7. (a) (i) Discuss a spectrophotometric method for the determination of binary formation constant of a complex.
       (ii) Distinguish between stepwise and overall stability constants.
   Or
   (b) Explain the factors affecting the stability of coordination compounds.

8. (a) Explain the mechanisms of redox reactions of metal complexes.
   Or
   (b) (i) Give an account of base hydrolysis of Cobalt(III) complexes.
       (ii) Discuss the various factors affecting the rates of substitution reactions of octahedral complexes.
DEPARTMENT OF INORGANIC AND ANALYTICAL CHEMISTRY

List of Experiments for M.Sc., previous Inorganic chemistry practicals

Semester – I

I. Inorganic Synthesis: Preparation of
- Tetraamminecopper(II) sulphate
- Potassium tris-oxalato ferrate(III) trihydrate
- Tris-thiourea copper(I) sulphate

II. Semimicro qualitative analysis of six radical mixtures
(One interfering anion and one less familiar cation for each mixture)

Anions:  CO₃²⁻, S²⁻, SO₃²⁻, Cl⁻, Br⁻, I⁻, NO₃⁻, SO₄²⁻, CH₃COO⁻,
         C₂O₄²⁻, C₄H₄O₆²⁻, PO₄³⁻, CrO₄²⁻, AsO₄³⁻, F⁻, BO₃³⁻

Cations: Ammonium (NH₄⁺)
1st group: Hg, Ag, Pb, Tl, W
2nd group: Hg, Pb, Bi, Cu, Cd, As, Sb, Sn, Mo
3rd group: Fe, Al, Cr, Ce, Th, Ti, Zr, V, U, Be
4th group: Zn, Mn, Co, Ni
5th group: Ca, Ba, Sr
6th group: Mg, K, Li

Semester – II

III Quantitative analysis:

a) Volumetric: i) Determination of Ferric iron by photochemical reduction
    ii) Determination of Nickel by EDTA
    iii) Determination of Calcium and Magnesium in a mixture by EDTA
    iv) Determination of Ferrocyanide by Ceric sulphate
    v) Determination of Copper(II) in presence of iron(III)

b) Gravimetric: i) Determination of Zinc as Zinc pyrophosphate
    ii) Determination of Nickel from a mixture of Copper and Nickel.