ANDHRA UNIVERSITY
DEPARTMENT OF INORGANIC AND ANALYTICAL CHEMSITRY
M.Sc. Previous Chemistry Syllabus, Semester I

Paper- II: Inorganic Chemistry-I

UNIT-1

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 ($PtCl_4^{2-}$) and Octahedral complexes (CoF_6^{3-}, $Co(NH_3)_6^{3+}$).

Walsh diagram for H_2O molecule.

UNIT-II

Inorganic cage and ring compounds – preparation, structure and reactions of boranes, carboranes, metallocarboranes, boron–nitrogen ($H_3B_3N_3H_3$), phosphorus–nitrogen ($N_3P_3Cl_6$) and sulphur-nitrogen (S_4N_4, $(SN)_x$) cyclic compounds.
Electron counting in boranes – Wades rules (Polyhedral skeletal electron pair theory).
Isopoly and heteropoly acids.

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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.

Term symbols – Russell – Sanders coupling – derivation of term symbols for various configurations. Spectroscopic ground states.

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 Dq, B and β parameters. Charge transfer spectra.

Magnetic properties of transition and inner transition metal complexes – spin and orbital moments – quenching of orbital momentum by crystal fields in complexes.

Text books:

1. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkinson, IV Edition, John Wiley and Sons, New York, 1980.
2. Inorganic Chemistry by J.E. Huheey, III Edition, Harper International Edition, 1983.
3. Theoretical Inorganic Chemistry, II Edition by M.C. Day and J. Selbin, Affiliated East-West press Pvt. Ltd., New Delhi.
4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press (1999

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 ClF_3, XeF_4 and SF_4 molecules using VSEPR theory.

Or

b) Draw the Walsh diagram for H_2O 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 $[TiCl_4]^-$ ion and explain the electronic transitions.

Or

(b) Calculate the spin only magnetic moments of the following ions:

(i) $[MnCl_6]^{3-}$ (ii) $[Fe(CN)_6]^{3-}$

SECTION-B

ANSWER ALL QUESTIONS 4x15=60 Marks

5. a) What is LCAO method? Predict bond order and bond lengths in O_2^+ and O_2^- ions based on MO energy level diagram.

Or

b) Draw the MO energy level diagram for $[Co(NH_3)_6]^{3+}$ and discuss its magnetic properties.

6. a) Discuss the preparation of, structure of, and bonding in $N_3P_3Cl_6$.

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 Ni^{2+} and identify the ground state term symbol .

8. (a) How do Tanabe – Sugano diagrams differ from Orgel diagrams? Draw Tanabe – Sugano diagram for $[V(H_2O)_6]^{3+}$ and explain the electronic transitions.

Or

(b) Discuss different types of paramagnetic behaviour of transiton metal complexes.

AND HRA UNIVERSITY
DEPARTMENT OF INORGANIC AND ANALYTICAL CHEMSITRY
M.Sc. Previous Chemistry Syllabus, Semester - II
Paper- II: Inorganic Chemistry - II

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.

$Re_2Cl_8^{2-}$, $Mo_2Cl_8^{4-}$, $Re_2(RCOO)_4X_2$, $Mo_2(RCOO)_4(H_2O)_2$, $Cr_2(RCOO)_4(H_2O)_2$, $Cu_2(RCOO)_4(H_2O)_2$, $Cr_2Cl_9^{3-}$, $Mo_2Cl_9^{3-}$, $W_2Cl_9^{3-}$, Re_3Cl_9, $Re_3Cl_{12}^{3-}$, $Mo_6Cl_8^{4+}$, $Nb_6X_{12}^{2+}$ and $Ta_6X_{12}^{2+}$.

Polyatomic clusters – Zintle ions, Chevrel phases.

UNIT-II

Organometallic compounds - 16 and 18 electron rules.

Isoelectronic relationship - Synthesis, structure, bonding and reactions of carbon monoxide, dinitrogen and nitric oxide complexes.

Isolobal relationship – H, Cl, CH_3, $Mn(CO)_5$; S, CH_2, $Fe(CO)_4$; P, CH, $Co(CO)_3$

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

UNIT-III

Metal Ligand equilibria in solution:

Step wise and overall formation constants and their interaction – trends in stepwise constants – factors affecting the stability of metal complexes – Pearson's theory of hard and soft acids and bases (HSAB), chelate effect and its thermodynamic origin, determination of stability constants of complexes – spectrophotometric method and pH –metric method.

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:

Substitution reactions of metal complexes – D, Id, Ia and A mechanisms – Ligand replacement reactions of metal complexes – Acid hydrolysis – factors affecting acid hydrolysis – Anation and Base hydrolysis of Cobalt(III) complexes. Ligand displacement reactions of square planar complexes of platinum (II). Factors affecting square planar substitution – trans effect (theories).

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

Text books:

1. Advanced Inorganic Chemistry by F.A. Cotton and R.G. Wilkinson, IV Edition, John, John Wiley and Sons, New York, 1980.
2. Inorganic Chemistry by J.E. Huheey, III edition, Harper International Edition, 1983.
3. Organometallic Chemistry-A unified approach by A. Singh and R.C. Mehrotra, Wiley Eastern Ltd.
4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press (1999)
5. Theoretical Inorganic Chemistry, II Edition by M.C. Day and J. Selbin, Affiliated East-West press Pvt. Ltd., New Delhi.
6. Mechanisims of Inorganic reactions in solution by D.Benson, MCgraw Hill, London, 1968.
7. Inorganic chemistry by K.F. Purcell and J.C.Kotz, W.B. Saunders company, New York, 1977.

DEPARTMENT OF INORGANIC AND ANALYTICAL CHEMISTRY

MODEL QUESTION PAPER

M.Sc. Previous Chemistry Syllabus Semester II

Paper- II: Inorganic Chemistry-II

(Effective from 2011-2012 admitted batch)

Time: 3 hours Max. Marks: 80

SECTION-A

ANSWER ALL QUESTIONS 4x5=20 Marks

1. a) Discuss the structure and magnetic property of $Cu_2(RCOO)_4(H_2O)_2$.

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.

SECTION-B

ANSWER ALL QUESTIONS 4x15=60 Marks

5. a) Discuss the preparation of, structures of and bonding in $Re_2Cl_8^{2-}$.

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: CO_3^{2-} , S^{2-} , SO_3^{2-} , Cl^- , Br^- , I^- , NO_3^- , SO_4^{2-}, CH_3COO^-

$C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, PO_4^{3-} , CrO_4^{2-}, AsO_4^{3-}, F^- , BO_3^{3-}

Cations : Ammonium (NH_4^+)
1^{st} group: Hg, Ag, Pb, Tl, W
2^{nd} group: Hg, Pb, Bi, Cu, Cd, As, Sb, Sn, Mo
3^{rd} group: Fe, Al, Cr, Ce, Th, Ti, Zr, V, U, Be
4^{th} group: Zn, Mn, Co, Ni
5^{th} group: Ca, Ba, Sr
6^{th} 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.