

ADVANCE CHEMISTRY- IV (INORGANIC CHEMISTRY)

CREDIT HOURS: 3

Course Objectives: Students will acquire knowledge about the physical and chemical properties of d- & f- block elements on the basis of their electronic configurations and will be able to work out structures of coordination compounds through development of understanding of coordinate compounds and chemical bonding.

1. Pi- acceptor Ligands:

Transition metal carbonyls (Mononuclear, Binuclear, Polynuclear), synthesis, bonding situation based on spectroscopic evidences; Theoretical rationalization of molecular structures, (close, nido, erachno), Synthesis. Characteristics and reactivity of derivatives of metal carbonyls (carbonylate anions, carbonyl hydrides and carbonyl halides); Metal nitrosyls including halonitrosyl and their derivatives.

2. Chemical bonding:

Metallic bond on the basis of band model, X-ray spectra and $N(E)$ curves, $n(E)$ curves. Binding energy in metals, conductors, semi-conductors and insulators. Effect of temperature and impurities on conductivity.

3. Coordination Compounds: (Structure & Bonding)

Development of coordination compounds, Rules of inorganic nomenclature for acids, salts, radicals, ions, iso and heteropoly anions & compounds. Hybridization in coordination compounds with coordination number from 2 to 9. MO diagrams for metal complexes of common geometry. Important features of CFT, d-orbitals splitting for various common geometries, measurement of $10 Dq$, factors effecting $10 Dq$. CFSE, factors influencing magnitude of variation in lattice and hydration energy for ions of first transition series.

4. The Covalent Bond (Structure & Reactivity):

- VSEPR model followed by VB theory (Hybridization, Resonance etc..) explanation of the structure of AB_2 , AB_3 , AB_2E , AB_4 , AB_3E , AB_2E_2 , AB_5 , AB_3E_3 , AB_6 , AB_5E , AB_4E_2 , AB_7 , AB_6E , AB_8 and AB_9 type molecules.
- Discussion of molecular orbitals and molecular structures of homonuclear molecules and ions, heteronuclear diatomic and polyatomic molecules and ions.
- Bent bond, bridge bond, four electrons-three centre bond.
- Shielding effect and effective nuclear charge, Factors affecting the magnitude of σ and Z_{eff} and their variation in the period table, Applications of Slater's rules, Polarization of ions, Fajan's rules and its applications.

5. Co-ordination compounds: (synthesis and properties)

Preparative methods. Techniques of studying complexes, stability constants. The spectrochemical series and colour of metal complexes. Diamagnetism and Paramagnetism, stereochemistry, John-Teller Theorem, Isomerism. Role of metal complexes in analytical chemistry, industry and nature.

6. Chemistry of the Lanthanides and Actinides

Nomenclature, Position in periodic table, occurrence, Separation, and electronic configuration, oxidation States, Complex Formation, shapes of f-orbitals, applications.

Evaluation Criteria

Examination	Type	Marks
Internal Examination	Sessional Work	15%
	Mid-Semester	25%
External Examination	Final Semester	60%

RECOMMENDED BOOKS:

1. J H Huheey, Inorganic Chemistry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (2008)
2. J. D. Lee, Concise Inorganic Chemistry, Elbs with Chapman and Hall, London
3. Introduction to Chemical Nomenclature by R.S. Cahn and O.E. dermer 2001. Butterworth (London).
4. Stereochemistry and bonding in Inorganic Chemistry by J.E. Ferguson 2001, Prentice Hall, New Jersey.
5. Chemical Bonds, and introduction to atomic and molecular structure by H.B. Gray 1973, W.A. Benjamin, Inc., London
6. Advanced Inorganic Chemistry F.A. Cotton and G.Wilkinson 6th Ed. 2001, Interscience, Publishers, London.
7. Coordination Compounds by S.F.A. Kettle, 1999, Nelson , (Nairobi Kenya).
8. Coordination Chemistry by B.A. Basallo and R. Johnson 1972 W.A. Benjamin, London.

ADVANCE CHEMISTRY LAB- IV (INORGANIC CHEMISTRY)

CREDIT HOURS: 1

1. Chromatographic Techniques:

- (a) Separation of metal ions by paper chromatography and their identification with the help of locating agents and comparison of R_f values.
- (b) Separation of anions by paper chromatography and their identification.

2. Aqueous acid-base Titrations:

- (a) Estimation of SO₂ and SO₃ in air and discharged from an industrial process.
- (b) Estimation of CO₂
- (c) Estimation of oxalic acid and H₂SO₄ in a mixture.
- (d) Estimation of H₃BO₃ and NaH₂BO₃ in a mixture.
- (e) Determination of %age composition of a mixture containing H₃BO₃ and CH₃COOH.

3. Precipitation Titrations:

- Estimation of following anions with the help of adsorption indicators:
- (i) Chloride (ii) Bromide (iii) Sulphate (iv) Chloride and Iodide in a mixture.

4. Complexometric Titrations:

- (a) Estimation of Mg⁺² Zn⁺² with EDTA (Direct titration).
- (b) Estimation of Ni⁺² with EDTA (Back titration).
- (c) Determination of Ca⁺² and Zn⁺² in mixture (Masking)
- (d) Determination of Cd²⁺ and Zn⁺² in a mixture (Demasking).

- (e) Determination of SO_4^{2-} and PO_4^{3-} with EDTA (Indirect titration).
5. **Redox Titrations:**
- (a) Use of Ceric sulphate solution for the estimation of the following:-
- Determination of iron in an iron ore.
 - Determination of nitrites.
- (b) Use of potassium iodate for the determination of the followings:
- Copper
 - H_2O_2
 - Commercial Hypochlorite
6. **Preparations:**
- Tris (ethylenediamine) nickle (II) Chloride 2-hydrate.
 - Sodium Cobaltinitrite.
 - Pot. Trioxalato Aluminate.
 - Ammonium sulphate Nickel (II) Sulphate.
 - Hexa aqua Chromium (III) Chloride.
 - Ammonium Sulphate Copper (II) Sulphate Pentahydrate.

Evaluation Criteria

Examination	Type	Marks
Internal Examination	Sessional Work	15%
	Mid-Semester	25%
External Examination	Final Semester	60%

RECOMMENDED BOOKS:

- J. Bassett, R. C. Denny, G. H. Jeffery and J. Mendham, Vogel's Text Book of qualitative Inorganic Analysis, the English Language Book Society and Longman, New York, (2008)
- Quantitative Analysis Chemistry, James S. Pritz, George H. Sehenk, 2001 Alby and Becon Inc. London.
- Theory and practice of chromatography by Prof. Dr. Javed Iqbal (2002).
- Instrumental analysis by Gary D. Christian and James E.O., Reilly, 2007, Allyn and bacon Inc., London.
- Hand Book of Organic reagents in Inorganic Analysis by ZAVIX Holzbecher and other 1976 Ellis Hurwod Limited, London.
- Experimental Inorganic Chemistry - W. G. Palmer, 2005.
- The analysis of minerals and ores of the rarer elements – W. R. Schoeller, and A. R. Powell, Charles, Griffin and Company Limited, 2004.