Bachelors with Chemistry as Major
4st Semester
CHM422J2: CHEMISTRY: SELECTED TOPICS IN INORGANIC CHEMISTRY

Credits: Theory-4, Lab-2

Theory (4 credits: 60 Hours) **Max. Marks: 100, Min Marks: 36**

Course Objectives:

This course covers basics and theories of bonding for coordination complexes and a brief discussion on bioinorganic chemistry. To provide students with basic understanding of redox and nuclear chemistry and understand the chemistry of inner transition elements.

Learning outcomes:

- *Provide basic understanding of coordination compounds, their bonding and applications.*
- *Importance of metal ions in biology and knowledge of various enzymes and their activities*
- *Understand the structure and importance of metalloproteins, synthetic oxygen carrier model compounds*
- *Understand balancing of redox reactions, trends in standard potentials, redox indicators, nuclear forces and application of radioisotopes*
- *Understanding of electronic, magnetic, and spectral properties of inner transition elements and applications ofthese elements*

Unit-I Coordination Chemistry Basics **(15 hours)**

Experimental verification of Werner's Theory. Effective atomic number and its significance, Geometrical and optical isomerism of MA_4B_2, MA_3B_3 and MABCD type complexes. Bonding models in coordination complexes: Limitations of VBT, Crystal field theory ofoctahedral tetrahedral and square planar complexes. Factors affecting magnitude of Δ. Pairing energy, CFSE calculations of weak and strong field ligands.Stability of coordination compounds(Thermodynamic and Kinetic) and factors affecting stability. Chelate and Macrocyclic effect. Spectrochemical series. Magnetic properties of transition metal complexes. Limitations of Crystal field theory. Analytical applications of coordination compounds.

Unit–II Bioinorganic Chemistry **(15 hours)**

Transport mechanism(uniport, symport and antiport) Siderophores and metallothionein. Ferritin and Transferrin: metal binding sites; incorporation and release of iron. Haemoglobin and Myoglobin: Structure, oxygen saturation curves; Bohr effect and cooperativity in haemoglobin, Hemerythrin and Hemocyanin: Structure and Dioxygen binding. Representative synthetic oxygen carrier model compounds (Vaska type complexes).

Unit-III: Nuclear Chemistry (15 hours)

Nuclear subatomic particles, nuclear forces (Meson theory), nuclear size and density. stability of nucleus: n/p ratio, binding energy, packing fraction, structure of nucleus- Shell model and Liquid drop model.Types of nuclear reactions, nuclear cross section, isotope separation methods.
Radioactivity: natural and induced. Radioactive decay- α-decay, β-decay, γ-decay; neutron, emission, positron emission and electron capture. Group displacement law and radioactive series. Measurement of radioactivity: ionization chamber, geiger counters, scintillation counters. Application of radioisotopes in chemical reactions (agriculture and medicine), Carbon dating, neutron activation and isotope dilution analyses
Radiation chemistry: Units of radiation; LET and G-Value. Dosimetry, radiation chemistry of oxygen.

Unit-IV Chemistry of Inner-Transition Elements (15 hours)

Electronic configuration, oxidation states, f-orbital's. Complexing behavior of inner transition elements (Stereochemistry and stability).Spectral and Magnetic Properties (comparison with transition metals). Consequences of Lanthanide contraction(case studies). Separation of Lanthanides by ion–exchange and solvent extraction methods. Selected examples of lanthanide complexes with nitrate, β-Diketonate, crown Ether and porphyrin type ligands. Homo and hetero dinuclearcoordination compounds, coordination polymers of lanthanide ions. Industrial application of Lanthanide complexes.

Books Recommended

1. Coordination Chemistry; Banerjee, D.; Tata Mc Graw Hill; 1997.
2. Concise Coordination Chemistry; Gopalan, R. & Ramalingam, V.; Vikas; 2003.
3. The Biological Chemistry of Elements; Frausto de Silva, J.J. R. & Williams, R.J.P.; Oxford; 1994.
4. Bio-inorganic Chemistry of Elements; Hussain Reddy, K.; New Age; 2005.
5. Concise Inorganic Chemistry; J.D. Lee; 5^{th}Edn., OUP/Wiley India Pvt. Limited, 2008
6. Chemistry of the Elements; N. N. Greenwood, A. Earnshaw; 2^{nd}Edn., Elsevier India, 2010.
7. Principles of Inorganic Chemistry; B.R. Puri, L.R. Sharma and K.C. Kalia; 33^{rd}Edn., Milestone Publishers & Distributors/ Vishal Publishing Co., 2017

Practical (2 credits: 60 Hours) **Max. Marks**: 50, **Min Marks:** 18

I. Preparation of the following coordination compounds: (Any 03 Experiments)

i) *Tristhioureacopper(I)sulphate monohydrate*:
ii) *Hexaamminecobalt(III) chloride*
iii) *Trisethylenediaminecobalt(III) chlorid*e
iv) *Ammonium dodecamolybedophosphate*

II. Potentiometric Titrations: (Any 02 Experiments)

i) Standardization of an iron (ii) solution with a standard dichromate solution and calculation of formal and transition potential values.
ii) Determination of purity of Ce (IV) Sulphate with a standard Iron (II) solution over Platinum and Calomel assembly
iii) Complexometric titration for determination of Ferro cyanide with standard Zinc (II) solution in order to establish the composition of the complex $K_2Zn_3[Fe(CN)_6]_2$

Books Recommended

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. J. B. Yadav, *Advanced Practical Physical Chemistry* ; ; Edition, 16 ; Goel Pub., 2006.