II SEMESTER

OC H 461: ADVANCED INORGANIC CHEMISTRY

Course Outcome

- Students will learn the predictions of spectral and structural properties of organic and inorganic molecules through symmetry elements and symmetry operation.
- Understand the halogen and noble gas chemistry.
- Study the chemistry of silicates and silicone polymers.
- Acquire knowledge on metallurgical aspects of oxide ores, metal oxides, nitrides, fluorides and sulphides.
- Study the chemistry of reactions in non-aqueous media.
- Learn the industrial biological applications of ceramic materials.
- Know the chemistry and applications of lanthanoids and actinoides.

UNIT-I Symmetry and Group Theory **[12 Hours]**

Symmetry elements and symmetry operations. Point groups used with Molecules: Concept of a group, definition of a point group. Classification of molecules into point groups. Subgroups. Hermann-Maugin symbols for point groups. Multiplication tables (C_{2V}, C_{2h} and C_{3V}). Matrix notation for the symmetry elements. Classes and similarity transformation. Representation of groups: The great orthogonality theorem and its consequences. Character tables (Cs, Ci, C_2, C_2v, C_{2h} and C_3v). Applications of group theory to chemical bonding (hybrid orbitals for σ-bonding in different geometries and hybrid orbitals for π-bonding. Symmetries of molecular orbitals in BF_3, C_2H_4 and B_2H_6.

UNIT-II **[12 Hours]**

Halogens and Noble gas chemistry: Interhalogens, psuedohalogens, polyhalide ions, oxyhalogen species, oxyacids of halogens, xenon oxides and fluorides.

Oxy and Peroxy acids of N, P and S.

Silicates: Structure, classification - silicates with discrete anions, silicates containing chainanion, silicates with layer structure, silicones with three-dimensional net-work and applications. **Silicones:** General methods of preparation, properties. **Silicone polymers**: silicone fluids, silicone greases, silicone resins, silicone rubbers and their applications.

UNIT-III **[12 Hours]**

Chemistry of Ti subgroup and inner transition elements

Trends in oxidations states, stereochemistry and ionic sizes of metals, comparison of 3d, 4d and 5d series by taking Ti and Ni subgroups as examples.

Lanthanoid Chemistry: General trends, Electronic, optical and magnetic properties. Abundance and extraction, General principles: conventional, solvent extraction and ion-exchange methods. Separation from monazite. Chemistry of principal oxidation states (II, III and IV). Stability of tetrahalides, dihalides and aqua ions of simple lanthanide compounds. Redox potentials. Uses: lanthanides as shift reagents, lanthanides as probes in biological systems. High temperature super conductors.

Actinoid Chemistry: General trends and electronic spectra. Occurrence and preparation of elements, Isolation of the elements: thorium and uranium, enrichment of uranium for nuclear fuel, uranium hydrides, oxides and chlorides. Chemical reactivity and trend. Chemistry of trans-uranium elements.

UNIT-IV **[12 Hours]**

Metallurgy and redox potentials: Methods of reduction of oxide ores, chemical and electrolytic reductions, Ellingham diagram, specialized techniques for the extraction of metals- Amalgamation, Hydrometallurgy, Solvent Extraction, Ion exchange chromatography. Reduction potentials, Latimer and Frost diagrams–features and applications. Effect of complexation on potential.

Metal oxides, nitrides and fluorides: Monoxides of the 3d metals, higher oxides and complex oxides, oxide glasses, nitrides and fluorides.

Sulfides, intercalation compounds and metal rich phases: Layered MS2 compounds and intercalation, Chevrel phases.

Ceramic materials: Sol-gel process and applications of biomaterials of ceramics.

References

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