

M.Sc. CHEMISTRY

FIRST SEMESTER

CH H 411: INORGANIC CHEMISTRY

Course Outcomes

- Learn the basics of ionic and covalent bonding, lattice and hydration energy,
- Enable the students to understand VSEPR and MOT theory.
- Enlighten the students to understand HSAB concept, non-aqueous solvents and ionic liquids.
- Get the knowledge alkali/alkaline earth metal complexes, compounds of boron, carbon and silicon.
- Understanding of use of organic precipitants and extraction techniques, masking and de-masking techniques, sampling techniques and statistical treatment of errors.

UNIT-I: Structures and Energetics of Ionic Crystals and Covalent Bonds [12 Hours]

Ionic Bond: Properties of ionic compounds, crystal lattices, closed packed structures, coordination number of an ion, radius ratio rule, structures of crystal lattices-NaCl, CsCl, ZnS and rutile. **Lattice energy:** Born Lande equation, Born-Haber cycle, uses of Born-Haber type of calculations. Covalent character in ionic bonds, Fajan's rules, **hydration energy** and solubility of ionic solids. Ionic radii, factors affecting the ionic radii, radius ratio rules.

Covalent Bond: Valence bond theory, resonance, hybridization and energetics of hybridization, Bent's rule, **VSEPR theory**-Deduction of molecular shapes. **MOT** of homo and heteronuclear diatomic and triatomic molecules & MO treatment for the molecules involving delocalized π -bonding (CO_3^{2-} , NO_3^- and CO_2). M.O. correlation diagrams (Walsh) for triatomic molecules.

UNIT-II [12 Hours]

Modern concept of acids and bases: Lux-Flood and Usanovich concepts, solvent system and leveling effect. **Hard-Soft Acids and Bases**, Classification and Theoretical backgrounds.

Non-aqueous solvents: Classification of solvents, Properties of solvents (dielectric constant, donor and acceptor properties), protic solvents (anhydrous H_2SO_4 , HF and glacial acetic acid), aprotic solvents (liquid SO_2 , BrF_3 and N_2O_4). Solutions of metals in liquid ammonia, hydrated electron. Super acids and super bases. Heterogeneous acid-base reactions.

Ionic liquids: Molten salt solvent systems, Ionic liquids at ambient temperature, Reactions in and applications of molten salt/ionic liquid media. Supercritical fluids: Properties of supercritical fluids and their uses as solvents. Supercritical fluids as media for inorganic chemistry.

UNIT-III [12 Hours]

Alkali and alkaline earth metal complexes of crown ethers, cryptands and calixarenes and their biological importance.

Synthesis, properties and structures of boron, carbon and silicon compounds: Chemistry of higher boranes, classification, structures and MO description of bonding, framework electron counting, Wade's rules, chemistry of B_5H_9 , $\text{B}_{10}\text{H}_{14}$ and $\text{B}_n\text{H}_n^{2-}$, boron nitride, borazines, carboranes, metalloboranes, metallocarboranes; Graphite, graphene, carbon nanotubes and zeolites. Cyclophosphazenes, phosphazene polymers and S-N compounds.

UNIT-IV [12 Hours]

Precipitation phenomena: precipitation from homogeneous solutions, organic precipitants in inorganic analysis. Solvent extraction of metal ions, nature of extractant, distribution law, partition coefficients, types of extractions and applications.

Theories of redox indicators, titration curves, feasibility of redox titrations.

Chelometric titrations: Titration curves with EDTA, feasibility of EDTA titrations, indicators for chelometric titrations, selective masking and demasking techniques, industrial applications of masking.

Sampling techniques and preparation of samples for analysis.

References

1. Inorganic Chemistry: Principles of Structure and Reactivity, 4th edn., J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi, Pearson Education (2009).
2. Shriver & Atkins' Inorganic Chemistry, 5th edn., P. Atkins, T. Overton, J. Rourke, M. Weller and F. Armstrong, Oxford University Press (2010).
3. Inorganic Chemistry, 2nd edn., C. E. Housecroft and A.G. Sharpe, Pearson Prentice Hall (2005).
4. Concise Inorganic Chemistry, 5th edn., J. D. Lee, New Age International (1996).
5. Concise Inorganic Chemistry, 5th edn., J. D. Lee, Blackwell Science (2000).
6. Concepts & Models of Inorganic Chemistry, B. E. Douglas, D. McDaniel & A. Alexander, Wiley (2001).
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8. Inorganic Chemistry, 3rd edn., J. E. Huheey, Harper and Row Publishers (1983).
9. Inorganic Chemistry, 5th edn., G. L. Miessler, P. J. Fischer and D. A. Tarr, Pearson (2014).
10. Inorganic Chemistry, 6th edn., D. F. Shriver, M. Weller. T. Overton, J. Rourke and F. Armstrong, Oxford University Press (2014).
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13. Concepts and Models of Inorganic Chemistry 3rd edition. B.E. Douglas, D.H. McDaniel and Alexander, Wiley (2001).
14. Ionic liquids-Classes and Properties, Ed. Scott T. Handy, Intech Publisher (2011).