11.1.5. Course Code: DSC5: CHEMISTRY-2 (C2)
Course Title: PERIODIC PROPERTIES AND CHEMICAL BONDING

Total Credits:4 (Credits: Theory-02, Practical-02)
(Total Lectures: Theory- 30, Practical-60)

Objectives: The course discusses the periodicity in properties with reference to the s, p and d block, which is necessary in understanding their group chemistry. It provides basic knowledge about ionic, covalent and metallic bonding underlining the fact that chemical bonding is best regarded as a continuum between the three cases. It provides an overview of hydrogen bonding and van der Waal forces which influence the melting points, boiling points, solubility and energetics of dissolution of compounds.

Learning Outcomes:
By the end of this course, students will be able to:

- Understand periodicity in ionization enthalpy, electron gain enthalpy, electronegativity and enthalpy of atomization.
- Understand variability in oxidation state, colour, metallic character, magnetic and catalytic properties and ability to form complexes
- Understand the concept of lattice energy using Born-Landé expression.
- Draw Born Haber Cycle and analyse reaction energies.
- Draw the plausible structures and geometries of molecules using VSEPR theory.
- Understand and draw MO diagrams (homo- & hetero-nuclear diatomic molecules).
- Understand the importance and applications of hydrogen and van der Wall bonding.

Unit I: Periodic Properties

Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy, inert pair effect.

General group trends of s, p and d block elements with special reference to Ionization Enthalpy, Electron Gain Enthalpy, Electronegativity, Enthalpy of Atomization, oxidation state, colour, metallic character, magnetic and catalytic properties, ability to form complexes

(Lectures: 12)

UNIT II: Bonding in coordination compounds

Ionic Bonding: General characteristics of ionic bonding, Lattice Enthalpy and Solvation Enthalpy and their relation to stability and solubility of ionic compounds, Born-Lande equation for calculation of Lattice Enthalpy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.
Covalent Bonding: Valence Bond Approach, Hybridization and VSEPR Theory with suitable examples, Concept of resonance and resonating structures in various inorganic and organic compounds, Molecular Orbital Approach: Rules for the LCAO method, bonding, nonbonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.
Metallic Bonding, Hydrogen Bonding, van der Waals Forces

(Lectures: 18)

PRACTICALS (Credits: 02; Laboratory Periods: 60)

1. Preparation of standard solutions of different normality and molarity of Mohr's salt and oxalic acid.
2. Estimation of free alkali present in different soaps and detergents (*At least two samples to be taken*).
3. Estimation of oxalic acid by titrating it with $KMnO_4$ (*Provide at least two unknown solutions*).
4. Estimation of Mohr's salt by titrating it with $KMnO_4$ (*Provide a tleast two unknown solutions*).
5. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
6. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal and external indicators.
7. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
8. Chromatographic separation of mixture of metal ions Cu^{2+}, Cd^{2+} and Ni^{2+}, Co^{2+}.

REFERENCES:

Theory:

- Huheey, J.E.; Keiter, E.A., Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry-Principles of Structure and Reactivity, Pearson Education
- Shriver, D.D.; Atkins, P.; Langford, C.H. (1994), Inorganic Chemistry 2nd Ed., Oxford University Press.
- Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Inorganic Chemistry, 5th Edition, W. H. Freeman and Company.

- Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India
- Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), Concepts and Models of Inorganic Chemistry, John Wiley & Sons.
- Wulfsberg, G (2002), Inorganic Chemistry, Viva Books Private Limited.
- Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), Inorganic Chemistry, 5th Edition, Pearson.

Practical:

- Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.

Teaching Learning Process:

- Conventional chalk and board teaching,
- Class interactions and discussions
- Power point presentation on important topics.

Assessment Methods:

- Class Tests at Periodic Intervals.
- Written assignment (s) / Presentation by individual students
- End semester University Theory and Practical Examination

Keywords: Ionization Enthalpy, Electron Gain Enthalpy, Electronegativity, Ionic Bonding, Dipole Moment, VSEPR Theory, Covalent Bonding, Metallic Bonding, van der Wall Forces.