ARSD College, University of Delhi

Model Course Handout/Lesson Plan

Course Name : B.Sc. Industrial Chemistry						
Semester	**Course Code**	**Course Title**	**Lecture (L)**	**Tutorial (T)**	**Practical (P)**	**Credit (C)**
VI	Course Code: DSC 1: INORGANIC CHEMISTRY - I	Atomic Structure & Chemical Bonding	0	1	0	1
Teacher/Instructor(s)		Dr. Preeti Chaudhary				
Session		2022-23				

Objectives:

The course reviews the structure of the atom, which is a necessary prerequisite in understanding the nature of chemical bonding in compounds. It provides basic knowledge about ionic, covalent and metallic bonding and explains that chemical bonding is best regarded as a continuum between the three cases. It discusses the periodicity in properties with reference to the s and p block, which is necessary in understanding their group chemistry.

Course Learning Outcomes:

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

- Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii, ionic radii, ionization energy and electron affinity of elements.
- Draw the plausible structures and geometries of molecules using Radius Ratio Rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules).
- Understand the concept of lattice energy using Born-Landé and Kapustinskii equation.
- Rationalize the conductivity of metals, semiconductors and insulators based on the Band theory.
- Understanding various concepts of acids and bases and applications of HSAB principle.

Detail of course

Unit 1:

Atomic Structure: Recapitulation of Bohr's theory & its limitations, atomic spectrum of hydrogen atom, de Broglie equation, Heisenberg's Uncertainty Principle and its significance. Postulates of wave mechanics, Time independent Schrödinger's wave equation, well behaved wave function, significance of ψ and ψ 2 . Quantum mechanical treatment of H- atom, Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial function plots, radialprobability distribution plots, angular distribution curves. Shapes of s, p, and d orbitals, Relative energies of orbitals. Pauli's Exclusion Principle, Hund's rule of maximum spin multiplicity, Aufbau principle and its limitations.

Unit 2:

Periodic properties of Elements & periodic trends: Brief discussion of the following properties of the elements, with reference to s- & p-block and their trends: (a) Effective nuclear charge, shielding or screening effect and Slater's rules (b) Atomic and ionic radii (c) Ionization enthalpy (Successive ionization enthalpies) (d) Electron gain enthalpy (e) Electronegativity, Pauling's/ Mulliken's/ Allred Rochow's/ and Mulliken-Jaffe's scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.

Unit-3

Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Lattice energy, Born-Landé equation with derivation, Madelung constant, importance of Kapustinskii equation for lattice energy. Born-Haber cycle and its applications. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

Unit 4:

Covalent bond: Lewis structure, Valence shell electron pair repulsion (VSEPR) theory, shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H2O, NH3, PCl3, PCl5, SF6, ClF3, I3 - , BrF2 + , PCl6 - , ICl2 - ICl4 - , and SO4 2- . Application of VSEPR theory in predicting trends in bond lengths and bond angles. Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and

electronegativity difference. Molecular orbital diagrams of homo & hetero diatomic and simple polyatomic molecules [N2, O2, C2, B2, F2, CO, NO] and their ions; HCl (idea of s-p mixing and orbital interaction to be given)

Details of the Lab Course		
Session	**Name of Experiment**	**Contact Hours**
1	General characteristics, types of ions,	**1**
2	Size effects, radius ratio rule and its limitations	**1**
3	Packing of ions in crystals.	**1**
4	Lattice energy	**1**
5	Born-Landé equation with derivation,	**1**
6	Madelung constant	**1**
7	Importance of Kapustinskii equation for lattice energy	**1**
8	Born-Haber cycle and its applications.	**1**
9	Covalent character in ionic compounds	**1**
10	polarizing power and polarizability	**1**
11	Fajan's rules	**1**
12	Consequences of polarization.	**1**
13	Valence Bond theory (Heitler-London approach).	**1**
14	Valence Bond theory (Heitler-London approach).	**1**
15	Valence Bond theory (Heitler-London approach).	**1**
	Total	**15**

Suggested Books:

1 Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.

2. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), Inorganic ChemistryPrinciples of Structure and Reactivity, Pearson Education.

3. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), Concepts and Models of Inorganic Chemistry, John Wiley & Sons.

4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.

5. Pfennig, B. W. (2015), Principles of Inorganic Chemistry. John Wiley & Sons.

6. Housecraft, C. E.; Sharpe, A. G., (2018), Inorganic Chemistry, 5th Edition, Pearson.

7. Wulfsberg, G (2002), Inorganic Chemistry, Viva Books Private Limited.

8. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), Inorganic Chemistry, 5th Edition, Pearson.

9. Shiver, D.; Weller, M.; Overton, T.; Rourke, J.; Armstrong, F. (2014), Inorganic Chemistry, 6th Edition, Freeman & Company

10. Das, A. K.; Das, M. (2014), Fundamental Concepts of Inorganic Chemistry, 1st Edition, Volume CBS Publishers & Distributors Pvt. Ltd.

Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment		25
	• Quiz		
	• Class Test		
	• Attendance		
	• Assignment		
2.	End Semester Examination	3 hr	75
		Total marks	100