COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

OFFERED BY DEPARTMENT OF CHEMISTRY FOR ODD SEMESTER

GE 1: Chemistry: Atomic Structure and Chemical Bonding

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course titl e & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Atomic Structure and Chemical Bonding (GE-1)	4	2		2		Basic knowledge of Chemistry

Learning Objectives

The Learning Objectives of this course are as follows:

- To discuss the structure of atom as a necessary pre-requisite in understanding the nature of chemical bonding in compounds.
- To provide basic knowledge about ionic and covalent bonding.

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, and shapes of s, p, and d orbitals
- Understand the concept of lattice energy and solvation energy.
- Draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules).

SYLLABUS OF GE 1

Theory:

Unit – 1: Atomic Structure (14 Hours)

Review of: Bohr's theory and its limitations, Heisenberg uncertainty principle, Dual behaviour of matter and radiation, De-Broglie's relation, Hydrogen atom spectra, need of a new approach to atomic structure. Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom, radial and angular parts of the hydrogen wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation), radial and angular nodes and their significance, radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and m_s. Shapes of s, p and d atomic orbitals, nodal planes, discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, electronic configurations of the atoms, stability of half-filled and completely filled orbitals, concept of exchange energy, relative energies of atomic orbitals, anomalous electronic configurations.

Unit – 2: Chemical Bonding and Molecular Structure (16 Hours)

Ionic Bonding: General characteristics of ionic bonding, energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds, statement of Born-Landé equation for calculation of lattice energy (no derivation), Born Haber cycle and its applications, covalent character in ionic compounds, polarizing power and polarizability, Fajan's rules. Ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR (H_2O, NH_3, PCl_5, SF_6, ClF_3, SF_4) and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for ss, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.

Practicals: (60 Hours)

(Laboratory Periods: 60)

1. Acid-Base Titrations: Principles of acid-base titrations to be discussed.

(i) Estimation of sodium carbonate using standardized HCl.
(ii) Estimation of carbonate and hydroxide present together in a mixture.
(iii) Estimation of carbonate and bicarbonate present together in a mixture.
(iv) Estimation of free alkali present in different soaps/detergents

2. Redox Titrations: Principles of oxidation-reduction titrations (electrode potentials) to be discussed.

(i) Estimation of oxalic acid by titrating it with $KMnO_4$.
(ii) Estimation of Mohr's salt by titrating it with $KMnO_4$.
(iii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iv) Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator (diphenylamine/ N-phenylanthranilic acid).

References:

Theory:

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 Chemistry- Principles 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.

Practicals:

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

Additional Resources:

1. Wulfsberg, G (2002), **Inorganic Chemistry**, Viva Books Private Limited.
2. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), **Inorganic Chemistry**, 5th Edition, Pearson.

GE 3: Chemistry: Bioinorganic Chemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Bioinorganic Chemistry (GE-3)	**4**	**2**		**2**		**Basic knowledge of Chemistry**

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce students to bioinorganic chemistry, currently a frontier area of chemistry providing an interface between organic chemistry, inorganic chemistry and biology.
- To make students learn about the importance of inorganic chemical species, especially metals, in biological systems, through discussions on topics such as the sodium-potassium pump, the applications of iron in physiology, including iron transport and storage system, role of magnesium in energy production and chlorophyll, toxicity of heavy metal ions and their antidotes.