SEMESTER 1st
MAJOR COURSE

CHM122J: CHEMISTRY-I

CREDIT: THEORY: 04; PRACTICAL: 02

THEORY (04 CREDITS: CONTACT HOURS: 64)

Course Objectives:

- *To introduce students to the basic concepts of Chemical Bonding., fundamental aspects of s block elements & acid base theories*
- *To understand the basic concepts of organic chemistry, electron displacements, stereo chemistry and reactive intermediates*
- *To have knowledge about the gaseous, liquid and solid states of matter.*

Learning outcomes:

On completion of the course, the student should be able to:

- *Understand the nature and strength of forces between chemical constituents, different theories of chemical bonding and acid base concepts.*
- *Recognize the key* reactive intermediates *in organic chemistry and understand different aspects of stereochemistry.*
- *Understand the structural and behavioral aspects of states of matter.*

UNIT I: Theories of Chemical Bonding and Molecular Structure

(16 Contact hours)

Types of bonding: Ionic and Covalent bonding- Factors affecting ionic and covalent bonding. Lattice energy and Born Haber cycle. Solvation energy and solubility of ionic solids. Covalent-character of ionic bond, Fajan's rules, Percentage ionic character of a polar covalent bond. Dipole moment and its applications.

Valence bond theory: Directional characteristics of covalent bond, types of hybridization and limitations of VB theory.

VSEPR theory: Recapitulation of assumptions; Shapes of molecules /ions. (VO_3^{-1}, SF_6, IF_7 , $SnCl_2$, XeF_2, XeF_6, $XeOF_4$); Bent's rule

Molecular orbital theory: MO treatment of homo & hetero nuclear diatomic molecules (N_2, O_2, CO & NO). Energy level diagrams, Bond order and its applications.

Unit II: Acid Base theories and s-Block Elements **(16 Contact hours)**

Acid-Base Theories: Arrhenius, Brønsted-Lowry, Lewis, Lux-Flood and Usanovich. Hard soft acid base principle.

Periodic Properties and their trends. Electronegativity: scales and applications.

Effective nuclear charge and its calculation by Slater rules.

Chemical Reactivity towards Water, Oxygen, Hydrogen, Nitrogen and Halogens. Anomalous behaviour and diagonal relationships (Lithium, Beryllium, Magnesium and Aluminum). Chemical characteristics of the compounds of alkali and alkaline earth metals (Oxides and Hydroxides). Hydrides: Classification and general properties.

Unit III: Fundamentals of Organic Chemistry (16 Contact Hours)

Basic concepts of electron displacements- Inductive & electrometric effects. Resonance and hyperconjugation Nucleophiles and electrophiles.
Reactive intermediates: Structure, generation and stability of carbocations, carbanions, free-radicals and carbenes.
Stereochemistry
Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis* - *trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms and E / Z Nomenclature (up to two C=C systems).

UNIT IV: States of matter (16 Contact Hours)

Gaseous State: Ideal Gas equation, Deviation of gases from ideal behavior, van der Waal's equation of state.
Critical Phenomenon: PV isotherms of real gases, continuity of states, the isotherms of van der Waal's equation. Relationship between critical constants and van der Waal's constants, the law of corresponding states, reduced equation of state.
Molecular velocities: Root mean square, average and most probable velocities (basic concepts only); qualitative discussion of the Maxwell's distribution of molecular velocities. Collision number, mean free path and collision diameter.
Liquid State:
Viscosity and Surface tension: Factors affecting viscosity and surface tension of liquids, methods of determination of viscosity of liquids- Ostwald and Falling ball methods and of surface tension -Stalagmometer method.
Solid State:
Laws of crystallography: (i) Law of constancy of interfacial angles (ii) Law of rational indices and (iii) Law of symmetry-.Symmetry elements in crystals, lattice planes and miller indices. Bragg's equation and derivation. Interplanar distances in terms of miller indices

Books Recommended:

1. Concise Inorganic Chemistry; J.D. Lee; 5thEdn., OUP/Wiley India Pvt. Limited, 2008
2. Chemistry of the Elements; N. N. Greenwood, A. Earnshaw; 2nd Edn., Elsevier India, 2010.
3. Principles of Inorganic Chemistry; B.R. Puri, L.R. Sharma and K.C. Kalia; 33rdEdn., Milestone Publishers & Distributors/ Vishal Publishing Co., 2017
4. Advanced General Organic Chemistry: A Modern Approach; S.K. Ghosh; 3rd Revised Edn., New Central, 2010.
5. Organic Chemistry; R.T. Morrison, R.N. Boyd, S. K. Bhattacharjee; 7th Edn., Pearson India, 2011.
6. Organic Chemistry; P.Y. Bruice; 8thEdn., Pearson Education, 2017.
7. Advanced Organic Chemistry; Dr. Jagdamba Singh and LDS Yadav; Pragati edition,2017.
8. Principles of Physical Chemistry; B.R. Puri, L.R. Sharma and L.S. Pathania; 47th Edn.,Vishal Pubs & Co, 2017.
9. Physical Chemistry; T. Engel, P. Reid,;3rd Edn., Pearson India, 2013.

PRACTICAL: 02 CREDITS (CONTACT HOURS: 64)

Course Objectives:

- *To prepare solutions of different concentrations.*
- *To detect and purify organic compounds by different methods.*
- *To determine surface tension and viscosity of different liquids.*

Learning outcomes:

On completion of the course, the student should be able to:

- *Prepare and standardize different solutions.*
- *Learn techniques of purification.*
- *Learn methods for determination of surface tension and viscosity of liquids.*

Section A: Inorganic Chemistry

1. Preparation of solutions of different concentrations; Standardization of solutions (acids and bases).
2. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
3. Volumetric estimation of oxalic acid by titrating it with KMnO4.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and sublimation.
2. Detection of N, S and halogens in organic compounds.
3. Separation of mixtures by Chromatography:
   Separation and Identification of the components in a given mixture of amino acids by paper chromatography

Section C: Physical Chemistry

1. Measurement of density and relative density of various liquids using pyknometer/density bottle.
2. Measurement of viscosity of given liquids using Ostwald Viscometer.
3. Measurement of surface tension of given liquids using stalagmometer.

Books Recommended:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Comprehensive Practical Organic Chemistry: Qualitative analysis Ahluwalia, V.K. &Sunita Dhingra; Universities Press, India, 2004.
4. Advanced Practical Organic Chemistry; N. K. Vishnoi; 3rdEdn; Vikas Publishing, 2009.
5. Advanced Practical Physical Chemistry; J.B. Yadav; Krishna Prakashan Media (P) Limited, 2015.
6. Advanced Physical Chemistry Experiments; J. N. Gurtu, A. Gurtu, PragatiPrakashan, 2008.