

B.Sc. 2nd SEMESTER
DISCIPLINE SPECIFIC COURSE (CORE)

CH220C: CHEMISTRY

Course Weightage: 04 Credit (Theory)

Max. Marks: 60

No. of Contact Hours: 60

Course Objectives:

To introduce students to basics of periodic table (P-block), hydrocarbons, organic reaction mechanisms and reaction rates.

Course outcomes: The students after learning the course will be able to:

1. *Understand the structure, bonding, synthesis, properties and use of the various compounds of P-block elements.*
2. *Acquire knowledge about the chemical properties of aliphatic hydrocarbons.*
3. *Gather knowledge of aliphatic substitution, aromatic substitution and elimination reaction mechanisms.*
4. *Understand the rates of second, third order reactions, the dependence of reaction rate on temperature and comparative account of photochemical and thermal reactions.*

UNIT I: P-Block elements

(15 Contact hours)

Boron family: Boranes; classification, properties, Structure and bonding with special reference to diborane. Empirical rules of bonding in higher boranes.

Carbon family: Silicates: Structure, bonding and classification

Nitrogen family: Allotropic forms of phosphorus. Structure and bonding of oxides and oxoacids of nitrogen and phosphorus.

Oxygen family: Structure and bonding of fluorides and oxyacids of Sulphur. *Hydrogen peroxide:* Preparation, properties and uses.

Halogens family: Structure and bonding of hydrogen halides, and oxoacids of halogens. Structure and bonding of Interhalogens, polyhalides and pseudohalogens.

Noble gases: Fluorides, oxides and oxyfluorides of xenon: Structure and bonding.

UNIT II: Chemistry of saturated and unsaturated hydrocarbons (15 Contact hours)

Alkanes: Low-reactivity of alkanes-chlorination and bromination. The Reactivity-Selectivity principle.

Alkenes: Structure of alkenes, Preparation of alkenes from alcohols and alkyl halides through elimination reaction, Hoffmann and Saytzev's rule, mechanistic and stereochemical implications. Mechanistic details including regioselectivity and stereochemical implications of halogenation, hydrohalogenation, hydroboration, epoxidation, hydroxylation and ozonolysis. 1, 2-addition of isolated diene. 1, 2 and 1, 4-addition reactions of conjugated dienes. Thermodynamic vs kinetic control.

Alkynes: Structure and acidic character of alkynes. Mechanisms of addition of halogens, hydrogen, halides, hydration, hydroboration and catalytic and metal-ammonia reductions of alkynes.

UNIT-III: Organic Reaction Mechanisms**(15 Contact hours)**

Aliphatic Substitution and Elimination reactions: Mechanistic details of S_N1 and S_N2 , E_1 and E_2 reactions. Effects of structure of alkyl halides, nature of nucleophiles, leaving groups, solvent and stereochemical implications of S_N reactions.

Aromatic Electrophilic Substitution reactions: General mechanism of aromatic electrophilic substitution reactions. (Halogenation, Nitration, Sulfonation, Friedel-Crafts alkylation and acylation reactions of Benzene). The second substitution- Effect of substituents on reactivity and orientation. Mechanisms of Gattermann, Houben-Houesch, Veils-Meir Haack and Riemer-Tiemann reactions.

Aromatic Nucleophilic Substitution Reactions (Aryl halides): S_NAr and Benzyne mechanism

UNIT-IV: Chemical Kinetics**(15 Contact hours)**

Order of reaction, derivation of integrated rate equations for second (two reactants) and third order reactions. Determination of order of reaction by differential rate, integration, half-life period and isolation methods.

Temperature dependence of reaction rates: Arrhenius equation, concept of activation energy.

Theories of chemical kinetics: Simple collision theory based on hard sphere model for atomic reactions, limitations.

Steady state and equilibrium approximation

Kinetics of thermal and photochemical reactions: Decomposition of hydrogen iodide and hydrogen-bromine.

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. Organic Chemistry; R.T. Morrison, R.N. Boyd, S. K. Bhattacharjee; 7thEdn, Pearson India, 2011.
5. Organic Reactions and Their Mechanisms; P.S. Kalsi; 4thEdn, New Age Int. Pvt. Ltd., 2017.
6. Organic Reaction Mechanisms; V.K. Ahluwalia, R.K. Parashar; 4thEdn, Narosa Publishing House, 2010.
7. Advanced Organic Chemistry; J. Singh, L.D.S Yadav; 14thEdn, PragatiPrakashan, 2017.
8. Organic Chemistry; P.Y. Bruice; 8thEdn. Pearson Education, 2017.
9. Principles of Physical Chemistry; B.R. Puri, L.R. Sharma and L.S. Pathania; 47thEdn, Vishal Pubs & Co, 2017.
10. Atkins' Physical Chemistry; P. Atkins, J. de Paula, J. Keeler; 11thEdn. Oxford University Press, 2018.
11. Physical Chemistry; T. Engel, P. Reid; 3rdEdn, Pearson India, 2013.

Section A: Physical Chemistry

1. Chemical Kinetics and Polarimetry:
 - a) To determine the specific reaction rate of the hydrolysis of methyl acetate /ethyl acetate catalyzed by hydrogen ions at room temperature.
 - b) To determine the angle of rotation and hence specific rotation of an optically active-compound.
 - c) To study the kinetics of inversion of cane sugar.

Section B: Organic Chemistry

1. Functional Group Identification: Aromatic hydrocarbons, unsaturation, carboxylic acids, carbonyl compounds, phenols, alcohols, amines, amides, nitro compounds.
2. Preparation, recrystallization, percent yield and identification (melting point) of the following reactions products (Any two).
 - (a) Bromination of Phenol/Aniline
 - (b) Benzoylation of Aniline/Phenol
 - (c) 2, 4-dinitrophenylhydrazone formation of aldehyde/Ketones.

Section C: Inorganic Chemistry

1. Determination of acetic acid concentrations in commercial vinegar using NaOH.
2. Determination of calcium content in chalk as calcium oxalate by permanganometry.
3. Determination of ferrous ions by dichromate method.

Books Recommended:

1. Vogel's Qualitative Inorganic Analysis; G. Svehla; 7th Ed., Pearson Education. 2013.
2. Vogel's Textbook of Quantitative Inorganic Analysis; Bassett, G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denny, 6th ed., ELBS; 2007.
3. Advanced Practical Inorganic Chemistry; Gurdeep Raj; Krishna Prakashan Media (P) Ltd; 2013.
4. Vogel's Textbook of Practical Organic Chemistry; B.S. Furniss, A.J. Hannaford, P.W.G. Smith, & A.R., Tatchell; 5th Edn., Pearson India, 2003.
5. Practical Organic Chemistry; F.G. Mann, & B.C. Saunders; Orient-Longman, 1960.
6. Laboratory Manual in Organic Chemistry; R.K. Bansal; 5th Revised Edn., New Age International Limited, 2008.
7. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis; V. K. Ahluwalia, R. Aggarwal; Universities Press, India, 2000.
8. Advanced Practical Organic Chemistry; N. K. Vishnoi; 3rd Edn; Vikas Publishing, 2009.
9. Advanced Practical Physical Chemistry; J.B. Yadav; Krishna Prakashan Media (P) Limited, 2015.
10. Advanced Physical Chemistry Experiments; J. N. Gurtu, A. Gurtu, PragatiPrakashan, 2008.
11. Inorganic Chemistry Practical; D. Pant, Bookrix, 2010.