



**Yogi Divine Society inspired,  
Sarvodaya Kelavani Samaj managed,  
Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot**

**(Autonomous)**

**Affiliated to Saurashtra University, Rajkot**

Re-Accredited at 'A' Level by NAAC

STAR college Scheme & Status by MST-DBT

UGC- College with Potential for Excellence (CPE)

UGC-DDU KAUSHAL Kendra

GAAA – Highest Grade A-1 by KCG, Government of Gujarat

GPCB-Government of Gujarat approved Environment Audit Center

UGC-Autonomous College

## **DEPARTMENT OF CHEMISTRY**

### **Integrated B.Sc.-M.Sc. CHEMISTRY**

#### **SYLLABUS**

## SEMESTER – I

16ICHCC01	<b>Core-1: Fundamentals of Chemistry-I</b>	5 hrs./wk	5 Credits
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### Objectives:

To enable the students to

- Understand elementary concepts of atomic structure, bonding, and periodicity of elements
- Understand molecular behavior of compounds in relation with their atomic bonding and electronic forces.
- Develop skills in the scientific method of planning, conducting, reviewing and reporting experiments of qualitative & quantitative chemical analysis.
- Develop skills in understanding, planning and performing experiments for titrimetric analysis.

### Unit – 1: Structure of Atom

(10 hrs.)

#### (1) Atomic Structure:

Bohr's Theory & its limitation, Quantum numbers, Shapes of orbital, Principles: Aufbau, Pauli, Hund, Electronic configurations

#### Wave mechanics

- De-Broglie's dual nature equation
- Heisenberg's uncertainty principle & its significance
- Significance of  $\psi$  and  $\psi^2$
- Schrodinger wave equation
- Normalized and orthogonal wave function
- Eigen function and Eigen value
- Postulates of wave mechanics
- Radial and angular distribution curves
- Radial and angular wave function for hydrogen atom
- Numerical.

### Unit – 2: Properties of Elements

(12 hrs.)

#### (2) Periodic Properties

Various periodic trends in periodic table

- Atomic radius
- Ionic radius – Effective nuclear charge
- Pauling's method for the determination of ionic radius
  - Shielding effect
  - Slater rule
- Ionization energy, Electron affinity
- Electronegativity – Pauling's/Mullikan's /Alred Rachow's and Mullican-Jaffe's electronegativity scales
- Factors affecting electronegativity with respect to bond order, partial charge hybridization, Sanderson electron density ratio.

### (3) Chemical Bonding

- Types of Bonds: Covalent, Covalent Co-ordinate, Ionic, Metallic, Vander Waal's Forces
- Hybridization:
  - $sp$  –  $BeCl_2$                        $sp^3d^2$  –  $SF_6$
  - $sp^2$  –  $BF_3$                          $dsp^2$  –  $PtCl_4$
  - $sp^3$  –  $CH_4$                          $d^2sp^3$  –  $[Fe(H_2O)_6]^{3+}$
  - $sp^3d$  –  $PCl_5$                        $sp^3d^3$  –  $IF_7$
- Sidgwick Powell rule
- Valence bond theory and its limitations
- VSEPR theory.

### Unit – 3: Chemistry of Elements-I

(12 hrs.)

#### (4) Chemistry of S & P block and Noble gas Elements

- Occurrence & Electronic configuration
- Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation.
- Complex formation tendency of p-block elements.
- Hydrides and their classification: ionic, covalent and interstitial. Basic beryllium acetate and nitrate.
- Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.
  - Boric acid and borates, Boron nitrides, Borohydrides (diborane), Carboranes, Silanes, Oxides and oxoacids of nitrogen, phosphorus and chlorine. Peroxo acids of Sulphur, Interhalogen compounds, Polyhalide ions and basic properties of halogens.

#### Noble gas

- Occurrence, Electronic configuration, rationalization of inertness of noble gases, Clathrates; Preparation and properties of  $XeF_2$ ,  $XeF_4$ ,  $XeF_6$ ,  $XeOF_4$ ,  $XeO_3$  and  $XeO_4$ ; Applications of Noble gases.

### Unit – 4: Fundamentals of Analytical Chemistry – I

(12 hrs.)

**(5) Quantitative Analysis:** Introduction, Types of quantitative analysis, Gravimetric analysis, Volumetric analysis.

#### Modes of Concentration:

- Introduction, Theory of solution, Solvent, Solute, Primary & Secondary standard solutions, Determination of molecular weight and eq. weight, Different modes of concentration - Normality, Molarity, Molality, Mole fraction, % W/W, % W/V, % V/V, ppm, ppb, ppt, Numerical.

#### (6) Inorganic Qualitative Analysis

- Introduction & Differentiation
- Solubility product, Common ion effect
- $H_2S$  scheme,  $NH_4Cl$  &  $NH_4OH$  scheme
- Borex bead test, Charcoal test, Cobalt nitrate test & Flame test

### Unit – 5: Fundamentals of Analytical Chemistry – II

(14 hrs.)

#### (7) Acid- Base & Buffers

- Introduction, Definitions – Acids and Bases

- Strong and weak electrolytes
- Degree of ionization
- Ionic product of water
- Ionization of weak acid and weak base
- pH scale
- Common ion effect
- Salt hydrolysis
- Calculation of hydrolysis constant & degree of hydrolysis & pH of different salts
- Buffers & types of buffers
- Mechanism of buffers
- Determination of pH of buffer by Henderson equation
- Buffer capacity

### (8) Acid- Base & Redox Titrations

- Introduction
- Acid – Base titration
  - Strong acid v/s Strong base
  - Weak acid v/s Strong base
- Redox titration
  - Oxalic acid –  $\text{KMnO}_4$
  - $\text{FeSO}_4$  –  $\text{K}_2\text{Cr}_2\text{O}_7$
  - FAS –  $\text{K}_2\text{Cr}_2\text{O}_7$
  - Iodo & Iodimetric.

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#### Text Books:

1. Puri, B. R.; Sharma, L. R. & Kalia, K. C. (2010-11) *Principles of Inorganic Chemistry*. New Delhi : Milestone
2. Bahl, Arun; Bahl, B. S.; Tuli, G. D. (2010) *Essential of Physical Chemistry*. New Delhi : S. Chand (ISBN No. 81-219-2978-4)

#### Reference Books:

##### Inorganic Chemistry

1. Madan, R. L. (2011) *Chemistry for degree student First year*. New Delhi: S. Chand (ISBN: 81-219-3230-0).
2. Lee, J. D. (2002, Fifth edition) *Concise Inorganic Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 0-632-05293-7).
3. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller & Fraser Armstrong (2010, Fifth edition) *Inorganic Chemistry*. Oxford: Oxford University Press (ISBN: 978-0-19-959960-8).

##### Analytical Chemistry

1. Douglas A. Skoog, West, Holler, Crouch (2004, Eighth edition) *Fundamental of Analytical Chemistry*. Mexico: Thomson-Brooks/Cole (ISBN: 81-315-0051-9).
2. Sharma, B. K. (2014) *Instrumental Method of Chemical Analysis*. Meerut: GOEL publishing House (ISBN: 978-81-8283-099-8).
3. Christian, Gary D.; Dasgupta, Purnendu K.; Schug, Kevin A. (2007, Sixth edition) *Analytical Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 978-81-265-1113-6).

## SEMESTER – I

16ICHCC02	<b>Core-2: Fundamentals of Chemistry-II</b>	5 hrs./wk	5 Credits
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### Objectives:

To enable the students to

- Understand the fundamental concepts of organic chemistry & chemistry of hydrocarbons.
- Understand & use basic concepts of Stereochemistry and conformation.
- Use concepts of thermodynamics to make predictions and give explanations about chemical systems and fundamental properties of matter.
- Recognize forces acting on interface & within molecules and methods of reducing them for accelerating chemical reactions.
- Develop skills in safe handling & calibration of analytical glassware and preparation of standard solutions used in quantitative analysis.
- Develop skills in the determination of basic physical properties.

### Unit – 1: Fundamentals of Organic Chemistry

(12 hrs.)

#### (1) Basics of organic compounds

- **Organic compounds:** Classification, Nomenclature, hybridization, shapes of molecules, influence of hybridization on bond properties.
- **Electronic displacement:** Study of various effects: Inductive effect, Electromeric effect, Resonance & Mesomeric effect and Hyper conjugation and their applications
- **Reaction Intermediates:** Hemolytic and heterolytic bond fission, Curly arrow rules, formal charges, Nucleophile, Electrophile, Nucleophilicity & Basicity, Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values.
- Types, shape, formation, relative stability of reaction intermediates - Carbocation, Carbanion, Carbon free radical, Carbene.
- Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

#### (2) Alkanes

- IUPAC nomenclature & Preparation
- Wurtz, Wurtz-Fittig, Kolbe, Corey-House reaction
- Free radical substitution
- Halogenation- Relative reactivity and stability
- Classification of Carbon atoms
- Physical & Chemical properties

### Unit – 2: Stereochemistry

(10 hrs.)

#### (3) Basics of Stereochemistry

- Isomerism - (Types & Details)
- **Optical Isomerism:** Chirality/Asymmetry
- Wedge-Dash Formula
- Fischer projection
- Newmann and Sawhorse projection and their Inter conversion
- Enantiomer

- Relative and Absolute configuration: D/L and R/S designation, CIP rules
- Molecules with Two or more chiral centre
- Meso Compounds & Diastereomer
- **Geometrical Isomerism:** Cis–Trans, Syn–Anti, E–Z with CIP rules
- Optical activity & Specific rotation
- Racemic mixture & Resolution

**Unit – 3: Cyclo alkanes and Conformational analysis (12 hrs.)**

**(4) Cyclo alkanes**

- Nomenclature of mono cyclic, poly cyclic compounds and Spiro compounds
- General methods of preparation: Freund, Perkin, Dieckmann
- Physical & Chemical properties
  - Bayer's strain theory
  - Relative stability

**Conformational Analysis of alkanes**

- Relative stability
- Energy Diagram for Ethane, Butane, Cyclohexane & Mono substituted Cyclohexane
- Chair, Boat and Twist boat form
- Relative stability with energy diagram

**Unit – 4: Gaseous State & Thermodynamics (12 hrs.)**

**(5) Gaseous state**

- Introduction
- General characteristics of gases
- Gas law : Boyle's law, Charles' law, Gay–Lussac law, Avogadro law
- Kinetic Molecular theory
- Graham's law of diffusion
- Deviation from ideal behavior
- Van der Waal's equation
- Derivation of Van der Waal's equation
  - Volume correction
  - Pressure
- Method of Liquefaction of gases

**(6) Thermodynamics – 1**

- Introduction
- System, surrounding, types of system
- Thermodynamic processes, Macroscopic properties
- State function & Path function
- Heat & work
- Zeroth law (Statement & Mathematical expression)
- First law (Statement & Derivation)

**Thermo chemistry**

- Exothermic and endothermic reactions
- Heat of reaction:
  - Combustion, Solution, Neutralization, Vaporization, Sublimation, Transition
- Hess's law
- Bond dissociation energy

**Unit – 5: Surface chemistry (14 hrs.)**

**(7) Surface Phenomena and Catalysis**

- Introduction
- Definitions – Adsorption, Absorption, Adsorbate, Adsorbent, Sorption, Desorption
- Types of Adsorption
- Difference between Physisorption & Chemisorption
- Adsorption isotherm
  - Langmuir Adsorption
  - Freundlich isotherm
- Applications: Ion exchange - Water softening - deionization of H<sub>2</sub>O- Medical application
- **Catalysis**
  - Introduction
  - Types of catalyst & catalysis
  - Characteristics of catalyst
  - Theory of catalysis
  - Acid base catalysis
  - Enzyme catalysis
  - Applications

### **(8) Basic Physical Properties**

- Introduction
- Classification of physical property, Additive property, Constitutive property & Additive - Constitutive property
- Molar volume and Determination of molar volume
- Definition, equations and applications of: Surface tension – Parachor, Dipole moment, Viscosity, Refractive Index.

#### **Text Books:**

1. Bansal, Raj K. (2009, Fifth) *A Textbook of Organic Chemistry*. New Delhi: New Age International (ISBN: 978-81-224-2025-8).
2. Bahl, Arun; Bahl, B. S.; Tuli, G. D. (2010) *Essential of Physical Chemistry*. New Delhi : S. Chand (ISBN No. 81-219-2978-4)

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##### **Organic Chemistry**

1. Ahluwalia, V. K. (2011, Fourth edition) *Organic Reaction Mechanism*. New Delhi: Narosa (ISBN: 978-81-8487-115-9).
2. T.W. Graham Solomons (2011, 10th edition) *Organic Chemistry*. Hoboken: John Willey & Sons (ISBN: 978-0-470-55659-7).
3. Clayden, Greeves, Warren & Wothers (2012) *Organic Chemistry*. Oxford: Oxford University Press (ISBN: 978-0-19-850346-0).
4. Agrawal, O. P. (2009, 46th edition) *Organic Chemistry: Reaction and Reagents*. Meerut: Krishna Prakashan Media (p) Ltd. (ISBN: 81-87224-65-7).
5. Morrison & Boyd (2009, Sixth edition) *Organic Chemistry*. New Jersey: Pearson Education (ISBN: 978-81-7758-169-0).

##### **Physical Chemistry**

1. Negi, A. S.; Anand, S. C. (2007, Second edition) *A Textbook of Physical Chemistry*. New Delhi: New age International Publisher (ISBN: 81-224-2005-0).
2. Peter Atkins (2006) *Atkin's Physical Chemistry*. Oxford: Oxford University Press (ISBN: 9780198700722).
3. Arun Bahl; B.S. Bahl (2009, First edition) *Numerical Problems in Physical Chemistry*. New Delhi: S. Chand (ISBN: 81-219-3084-7).
4. Madan, R. L. (2011) *Chemistry for degree student Second year*. New Delhi: S. Chand (ISBN: 81-219-3538-5).

## SEMESTER – I

<b>16ICHCC03</b>	<b>Core Practical-1: Inorganic/Analytical Chemistry Practical</b>	<b>6 hrs./wk</b>	<b>3 Credits</b>
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- Demonstrative Practical:
  - Calibration of Volumetric Glassware
  - Preparation & Standardization of Analytical Solutions (including Buffer solutions)
- Inorganic Qualitative Analysis – Two Radicals (Minimum- 08 salts)
- Volumetric Analysis – Acid – Base titrations (Minimum-06), Redox titrations (Minimum-04),
- Gravimetric Analysis – Weight loss on Heating & LOD (Minimum-02 each)

## SEMESTER – I

<b>16ICHCC04</b>	<b>Core Practical-2: Organic/Physical Chemistry Practical</b>	<b>4 hrs./wk</b>	<b>2 Credits</b>
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- Demonstrative Practical:
  - Calibration of Thermometer
  - Calibration of volumetric glassware used in physical chemistry
- Determination of basic physical properties:
  - Surface tension – Parachor (02),
  - Viscosity (02),
  - Refractive Index (01),
  - Heat of Reaction (02),
  - Adsorption (01)
- Preparation of Reagents (Tollens', Nessler's, Neutral FeCl<sub>3</sub>, Sodium cobaltinitrite etc.)
- Determination of Chemical Nature, M.P. & B.P. (Minimum-08)

### Reference Books:

1. Brian S. Furniss (1989, Fifth edition) *Vogel's Textbook of Practical Organic Chemistry*. Hoboken: John Willey & Sons (ISBN: 0-582-462363).
2. Hassner, A. (2012, Third edition) *Organic Syntheses Based on Name Reactions*. Philadelphia: Elsevier Publishing company (ISBN: 978-0-08-096630-4).
3. Jeffery, G. H.; Bassett, J.; Mendham, J.; Denny, R. C. (1989) *Vogel's Textbook of Quantitative Chemical Analysis*. Hoboken: John Willey & Sons (ISBN: 0-582-44693-7).
4. Jerry R. Mohrig (2010, Third edition) *Techniques in Organic chemistry*. London: W. H. Freeman & Company (ISBN: 1-4292-1956-4).
5. Svehla, G. (1979, Fifth edition) *Textbook of macro and semi micro qualitative analysis*. London: Logman Publishing group (ISBN: 0-582-44367-9).



## SEMESTER – II

16ICHCC05	<b>Core-3: Fundamentals of Chemistry- III</b>	<b>5 hrs./wk</b>	<b>5 Credits</b>
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### Objectives:

To enable the students to

- Understand concepts of State of Matter, Co-ordination theory and Molecular orbital theory.
- Identify correctly various possible errors and use significant figures in experiment reports.
- Develop skill in understanding and performing of titrimetric analysis.
- Develop skills in the scientific method of conducting experiments and drawing inferences to identify simple organic compounds.

### Unit – 1: Coordination Chemistry

(12 hrs.)

#### (1) Elements of the first transition series

- Introduction, Electronic Configuration & Reversal of Energies of 3d and 4s orbital
- Physical Properties: Metallic, Crystal Structure, Conductivity, Density
- Catalytic Properties & Tendency of Formation of Alloys
- Atomic Properties: Atomic and Ionic Radii, Ionization Potential and Oxidation states & its stability
- Magnetic & Spectral Properties
- Non stoichiometric defects & Interstitial Compounds

#### (2) Coordination Compounds

- Introduction, Double salts
- Werner's coordination theory
- Ligand & its types
- Coordination Compounds
- Chelating ligand & Chelates
- Application of Coordination compounds

#### Isomerism in complexes

- Werner's classification
- Structural & Geometrical isomerism
- Structure & Complex of compounds having coordination No. 4 & 6.

### Unit – 2: Molecular Orbital Theory

(12 hrs.)

- Characteristics of MOT
- Comparison between VBT & MOT
- Linear Combination of Atomic Orbital
- Bond order Difference between (a) BMO & ABMO (b) Gerade & Ungerade
- Electronic configuration & Energy level diagram of homonuclear and heteronuclear diatomic molecules: H<sub>2</sub>, He<sub>2</sub>, Li<sub>2</sub>, Be<sub>2</sub>, B<sub>2</sub>, C<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>, F<sub>2</sub>, Ne<sub>2</sub>, NO & CO
- Determination of wave function & wave equation
- Determination of Potential energy of H<sub>2</sub> and H<sub>2</sub><sup>+</sup>
- Hybridization and Construction of Hybrid orbital
- Derivation of Wave equation and wave function of – sp, sp<sup>2</sup> and sp<sup>3</sup>

## Unit – 3: Solid State

(14 hrs.)

### (4) Ionic solids

- Introduction
- Characteristics of Ionic solids
- Born-Haber Cycle
- Max Born Equation
- Limiting radius ratio
- Relation between radius ratio, coordination number and crystal structure
- Derivation of  $r^+/r^-$  ratio in trigonal, square planar, body centered and tetrahedral crystal lattice
- Crystal structure of ionic solids: HCP, BCP and FCC
- Crystal structure of ionic solids
  - AB type - CsCl and ZnS (Zinc blend)
  - AB<sub>2</sub> type - CaF<sub>2</sub> and TiO<sub>2</sub>
- Defects in Ionic Crystal Lattice (Stoichiometric and Non stoichiometric)

### (5) Crystalline state

- Difference between crystalline and amorphous solid, Crystal and crystallography
- Three laws of crystallography
- Space lattice and Unit cell, Bravais lattices
- Type of cubic lattice and inter planar spacing
- X- rays Diffraction: Bragg's equation, Experimental methods (Rotating crystal and Powder method), Structure of Rock salt (NaCl) and Sylvian (KCl)
- **Liquid Crystals:** Introduction, Definition and Classification of liquid crystals (Smectic, Nematic, Cholesteric and Disc shaped)

## Unit – 4: Fundamentals of Analytical Chemistry-III

(10 hrs.)

### (6) Errors and Statistics

- Explanation of Errors and Mistake
- Classification of errors, Determinate and indeterminate errors,
- Operational and personal errors, Instrumental errors and reagent errors, additive and proportional errors
- Accuracy and precision, minimization of error
- Calibration of Instruments, blank measurement, independent method parallel method, Standard addition method
- Explanation of Significant figure and its laws with complete interpretation
- Mean and standard deviation, variance and coefficient of variance
- Absolute error and relative error, mean value, deviation and relative mean deviation.
- Gaussian curve and its explanation
- Importance of Q-test and T-test (Student's T-test )
- Example on errors, significant figures, Q-test and T-test

### (7) Organic Qualitative Analysis

- Introduction, Nature of organic compounds
- Unsaturation test
- FeCl<sub>3</sub> test

- Elemental analysis
- Functional group tests
- Determination of Physical constant
- Derivatization

## Unit – 5: Titrimetric Analysis

(12 hrs.)

### (8) Complexometric & Non aqueous Titrations

- **Complexometric titration**
- Method of preparation of standard EDTA Solution
- Velcher's law explanation of  $p_m \rightarrow$  EDTA vol., Graph with stability constant value.
- Types of EDTA Titration (I) Direct Titration (II) Back Titration (III) Substitution Titration (IV) Alkalimetry titration mixture with the help of masking and demasking agent
- Principle of metal ion indicator, Use of EBT, Calcon, Muroxide with structure and characteristic.
- **Precipitation titration**
- Argentometric titration
  - Mohr method
  - Fajans method
  - Volhard method
- **Non aqueous titration** : Theory , Acid-base reactions, Organic solvents , Non aqueous solvents used, Titration of halogen acid salts of bases, Indicators, Examples.

### (9) Water Analysis

- Introduction, Total solid & Volatile solid
- Non filterable, Filterable solid & Non filterable volatile solid
- Total Dissolved Solid, Total Suspended Solid ,
- Acidity, Alkalinity & Turbidity
- Hardness of Water, Different methods for determination of hardness of water.

#### Text Books:

1. Puri, B. R.; Sharma, L. R. & Kalia, K. C. (2010-11) *Principles of Inorganic Chemistry*. New Delhi : Milestone.
2. Bahl, Arun; Bahl, B. S.; Tuli, G. D. (2010) *Essential of Physical Chemistry*. New Delhi : S. Chand (ISBN No. 81-219-2978-4)

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3. Peter Atkins, Tina Overton, Jonarthan Rourke, Mark Weller & Fraser Armstrong (2010, Fifth edition) *Inorganic Chemistry*. Oxford: Oxford University Press (ISBN: 978-0-19-959960-8).

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2. Sharma, B. K. (2014) *Instrumental Method of Chemical Analysis*. Meerut: GOEL publishing House (ISBN: 978-81-8283-099-8).
3. Christian, Gary D.; Dasgupta, Purnendu K.; Schug, Kevin A. (2007, Sixth edition) *Analytical Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 978-81-265-1113-6).

## SEMESTER – II

<b>16ICHCC06</b>	<b>Core-4: Fundamentals of Chemistry- IV</b>	<b>5 hrs./wk</b>	<b>5 Credits</b>
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### Objectives:

To enable the students to

- Understand & reproduce the nomenclature, learn physical & chemical properties and plan the preparation of Alkenes, Alkynes, Dienes, Alcohols, Phenols, Ethers and Epoxide, Alkyl halide and Aryl halide
- Use concepts of chemical kinetics for making predictions and explanations of type, rate and order of reactions.
- Develop understanding regarding aromatic behavior of organic compounds and their typical chemical properties.
- Understand the concept of Solutions, Colloidal state & Chemical equilibrium.
- Develop skills in the scientific method of conducting experiments and determining basic properties of chemical entities.

### Unit – 1: Chemistry of Hydrocarbons

(12 hrs.)

#### (1) Aromatic Hydrocarbons

- Structure of benzene, toluene
- Electrophilic aromatic substitution, Nitration, Sulphonation, F.C.R- Alkyl & Acylation, halogenations with mechanism
- Directing effects of the groups
- **Aromaticity**
- Hückel's rule, Benzenoid and non benzenoid structures

#### (2) Alkenes, Alkynes and Dienes

- **Alkenes:** Nomenclature
- Preparation by elimination
  - Dehydration of alcohol
  - Dehydrohalogenation of alkyl halide
- Physical & Chemical properties
- Polymerization
- Markovnikov's –Anti-Markovnikov's – Saytzeff's rules
- **Alkynes:** Preparation, Physical & Chemical properties
- Polymerization
- **Dienes:** Classification, Preparation, Diels–Alder
- Addition reaction (1,2- & 1,4-) for 1,3-butadiene

### Unit – 2: Functional Group Chemistry

(14 hrs.)

#### (3) Alkyl halide and Aryl halide

- **Alkyl halide**
- Nomenclature, Classification & Preparation
- $SN^1$  &  $SN^2$  reaction mechanism
- $E^1$  &  $E^2$  reaction mechanism
- Substitution and elimination reaction of alkyl halide
- **Aryl halide**
- Nomenclature, Classification & Preparation

- Nucleophilic aromatic substitution with reactivity & orientation
- Benzyne, Elimination–Addition reaction
- Relative reactivity of Alkyl halide, Aryl halide, Vinyl halide
- (4) Alcohols, Phenols, Ethers and Epoxide**
  - **Alcohols:** IUPAC Nomenclature & Classification
  - Physical & Chemical properties
  - **Phenols:** IUPAC Nomenclature & Classification
  - Industrial Production of Phenol
    - Dow Process
    - Cumene Process
  - Physical Properties
  - Chemical Properties
    - Reactions of O-H group
    - Reactions of aromatic ring
  - Relative acidity of Alcohols and Phenols
  - **Ethers :** IUPAC Nomenclature, Classification & Preparation
  - Physical & Chemical properties
  - **Epoxides**
  - Preparation
  - Reaction with (a) alcohol (b) ammonia derivatives (c)  $\text{LiAlH}_4$

### Unit – 3: Properties of Solution and Chemical Kinetics

(14 hrs.)

- (5) Dilute Solutions and Colligative Properties**
  - Introduction
  - **Colligative properties**
  - Raoult's law and its derivation
  - Determination of molecular mass from lowering of vapour pressure by different method
  - Boiling point elevation
  - Relation between boiling point elevation & lowering of vapour pressure
  - Determination of molecular mass from boiling point elevation by different method
  - Depression in freezing point
  - Determination of molecular mass from Depression in freezing point by different method
  - Colligative properties of electrolytes
  - Numerical
- (6) Chemical Kinetics**
  - Introduction
  - Order and molecularity of reaction
  - Derivation, Characteristics, Half-life time & Examples of
    - Zero order reaction
    - First order reaction
    - Second order reaction
    - Third order reaction
    - Pseudo Unimolecular reaction
  - Method for determining the order of reaction: (I) Graphical method (II) Ostwald isolation method (III) Method of half-life period (V) Integration method
  - Energy of Activation and catalysis

### Unit – 4: Chemical Equilibrium

(08 hrs.)

- Introduction
- Nature, criteria & Characteristics of chemical equilibrium

- Law of active masses
- Thermodynamic derivation of relations between the various equilibrium constants:  $K_p$ ,  $K_c$  and  $K_x$ .
- Heterogeneous and homogeneous equilibrium
- Le Chatelier's principle, Equilibrium constants and their quantitative dependence on temperature, pressure and concentration

### Unit – 5: Colloidal State

(12 hrs.)

- Introduction & Classification of colloidal solutions
- Characteristics of hydrophilic and hydrophobic sols
- Stability of colloids and origin of charge on colloid particles
- Emulsification and de-emulsification
- Preparation of colloidal solution: Lyophilic & Lyophobic solution
- Preparation methods:
  - (I) Condensation methods such as by Double decomposition, Hydrolysis, Reduction, Oxidation, Exchange of solvent, controlled condensation, change of physical state in short.
  - (II) Dispersion methods such as Bredig's arc method, Grinding, Peptization.
- Purification of colloidal solution : (I) Dialysis (II) Ultra filtration (III) Ultra centrifuging
- Stability of colloids solution
- Properties of colloidal solutions: (I) Optical properties such as Tyndall effect, Brownian motion
- Electrical properties: Electrical Double Layer Charge, Electrophoresis, Electro-osmosis.
- The Protective colloid (gold number)
- Applications.

#### Text Books:

1. Bansal, Raj K. (2009, Fifth) *A Textbook of Organic Chemistry*. New Delhi: New Age International (ISBN: 978-81-224-2025-8).
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##### Organic Chemistry

1. Ahluwalia, V. K. (2011, Fourth edition) *Organic Reaction Mechanism*. New Delhi: Narosa (ISBN: 978-81-8487-115-9).
2. T.W. Graham Solomons (2011, 10th edition) *Organic Chemistry*. Hoboken: John Wiley & Sons (ISBN: 978-0-470-55659-7).
3. Clayden, Greeves, Warren & Wothers (2012) *Organic Chemistry*. Oxford: Oxford University Press (ISBN: 978-0-19-850346-0).
4. Agrawal, O. P. (2009, 46th edition) *Organic Chemistry: Reaction and Reagents*. Meerut: Krishna Prakashan Media (p) Ltd. (ISBN: 81-87224-65-7).
5. Morrison & Boyd (2009, Sixth edition) *Organic Chemistry*. New Jersey: Pearson Education (ISBN: 978-81-7758-169-0).

##### Physical Chemistry

1. Negi, A. S.; Anand, S. C. (2007, Second edition) *A Textbook of Physical Chemistry*. New Delhi: New age International Publisher (ISBN: 81-224-2005-0).
2. Peter Atkins (2006) *Atkin's Physical Chemistry*. Oxford: Oxford University Press (ISBN: 9780198700722).
3. Arun Bahl; B.S. Bahl (2009, First edition) *Numerical Problems in Physical Chemistry*. New Delhi: S. Chand (ISBN: 81-219-3084-7).

## SEMESTER – II

<b>16ICHCC07</b>	<b>Core Practical -3: Inorganic/Analytical Chemistry Practical</b>	<b>6 hrs./wk</b>	<b>3 Credits</b>
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- Inorganic Qualitative Analysis – Two Radicals (Minimum- 06 salts)
- Inorganic Preparations & Purification (Minimum- 05)
- Titrimetric Analysis: Complexometric, Iodo & Iodimetric (Minimum- 08)
- Non aqueous & Precipitation Titrations (Minimum- 04)
- Water Analysis (Minimum- 04)

## SEMESTER – II

<b>16ICHCC08</b>	<b>Core Practical-4: Organic/Physical Chemistry Practical</b>	<b>4 hrs./wk</b>	<b>2 Credits</b>
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- Chemical Kinetics (Minimum-08)
  - First & Second Order kinetics
  - Energy of Activation
- Colloidal Chemistry
- Organic Qualitative Analysis (Minimum-10)
- Separation of Organic Binary mixtures (Based on Chemical Nature & Solubility) (Minimum-08)
- Organic Estimations (Minimum-04)

### Reference Books:

1. Brian S. Furniss (1989, Fifth edition) *Vogel's Textbook of Practical Organic Chemistry*. Hoboken: John Willey & Sons (ISBN: 0-582-462363).
2. Hassner, A. (2012, Third edition) *Organic Syntheses Based on Name Reactions*. Philadelphia: Elsevier Publishing company (ISBN: 978-0-08-096630-4).
3. Jeffery, G. H.; Bassett, J.; Mendham, J.; Denny, R. C. (1989) *Vogel's Textbook of Quantitative Chemical Analysis*. Hoboken: John Willey & Sons (ISBN: 0-582-44693-7).
4. Jerry R. Mohrig (2010, Third edition) *Techniques in Organic chemistry*. London: W. H. Freeman & Company (ISBN: 1-4292-1956-4).
5. Svehla, G. (1979, Fifth edition) *Textbook of macro and semi micro qualitative analysis*. London: Longman Publishing group (ISBN: 0-582-44367-9).