



**Sarvodaya Kelavani Samaj managed,  
Shri Manibhai Virani and Smt. Navalben Virani Science College  
(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 –Grade A-1 by KCG, Government of Gujarat

GPCB-Government of Gujarat approved Environment Audit Center

Nodal Center for capacity building by GSBTM

**Department of Chemistry**

**B.Sc. Chemistry**

**Syllabus**

**Semester-I**

<b>Discipline Specific Course- Core-1</b>		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: <b>Chemistry</b>	Offered to: <b>B.Sc. Chemistry</b>	
<b>Semester - I</b>		
Course Code	Course Title	Course Credit and Hours
<b>21UCHCC101</b>	<b>Introductory Inorganic and Analytical Chemistry (F)</b>	<b>4 Credits - 4 hrs/wk</b>

**Course Description:**

This course gives an introduction to inorganic and analytical chemistry and an overview of important analytical methods and their range of application within detection of inorganic and organic compounds. It also explain the theoretical principles and important applications of classical analytical methods within titration (acid/base titration, complexometric titration, redox titration), and various techniques within gravimetric and volumetric methods which helps in evaluation/interpretation of results. This course also reinforces the basic understanding of Bond theory: Atomic orbitals importance for chemical bonding, covalent bonding, ionic and lattice enthalpy, metal bonding, metals, etc. The course aims to address SDG No-4: Quality education.

**Course Purpose:**

This course aims to provide fundamental knowledge of structure of atom, bonding, periodicity of elements which involves the molecular behavior of compounds in relation with their atomic bonding and electronic forces. This course is sketched in such a way that students will able to understand the rudimentary scientific skill of planning, conducting, reviewing and reporting experiments of qualitative & quantitative chemical analysis.

**Course Outcomes:** Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level (K <sub>1</sub> to K <sub>6</sub> )
CO <sub>1</sub>	Remember basic idea of structure of atom and its mechanics.	K1
CO <sub>2</sub>	Understand the periodic properties, shape, geometry of various elements and their compound.	K2
CO <sub>3</sub>	Apply basic knowledge and predict the properties of the main block element.	K3
CO <sub>4</sub>	Correlate and Compare various methods for preparations of different concentrated solutions.	K2,K3

CO <sub>5</sub>	Understand and apply knowledge of acid base, redox and non-aqueous titration.	K2,K3
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Course Content	Hours
<b>Unit-I : Structure of Atom</b>	<b>12hrs</b>
<p><b>Atomic Structure &amp; Wave mechanics:</b></p> <ul style="list-style-type: none"> <li>• Quantum numbers</li> <li>• Shape of orbitals</li> <li>• Principles of Electronic configuration: AufBau, Pauli, Hund</li> <li>• De-Broglie's dual nature equation</li> <li>• Heisenberg's uncertainty principle &amp; its significance</li> <li>• Significance of <math>\psi</math> and <math>\psi^2</math></li> <li>• Schrodinger wave equation</li> <li>• Normalized and orthogonal wave function</li> <li>• Eigen function and Eigen value</li> <li>• Postulates of wave mechanics</li> <li>• Radial and angular distribution curves</li> <li>• Radial and angular wave function for hydrogen atom</li> </ul>	
<b>Unit-II: Properties of Elements</b>	<b>12 hrs</b>
<p><b>Periodic Properties</b></p> <ul style="list-style-type: none"> <li>• Various periodic trends in periodic table <ul style="list-style-type: none"> <li>➤ Atomic radius</li> <li>➤ Ionic radius – Effective nuclear charge</li> <li>➤ Pauling's method for the determination of ionic radius</li> <li>➤ Ionization energy</li> <li>➤ Electron affinity</li> <li>➤ Electronegativity</li> <li>➤ Slater's rule</li> </ul> </li> </ul> <p><b>Chemical Bonding</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• <b>Types of Bonds:</b> <ul style="list-style-type: none"> <li>➤ Covalent</li> <li>➤ Co-ordinate Covalent</li> <li>➤ Ionic</li> <li>➤ Metallic</li> <li>➤ Vander Waal's Forces</li> <li>➤ Hydrogen Bond</li> </ul> </li> <li>• <b>Hybridization:</b> <ul style="list-style-type: none"> <li>➤ Sp, sp<sup>2</sup>, sp<sup>3</sup>, sp<sup>3</sup>d, sp<sup>3</sup>d<sup>2</sup>, sp<sup>3</sup>d<sup>3</sup></li> </ul> </li> <li>• Valence bond theory and its limitations</li> <li>• VSEPR theory (Sidgwick- Powell rule) and geometries of molecules</li> </ul>	

<b>Unit- III: Chemistry of Elements-I</b>	<b>10 hrs</b>
<p><b>Chemistry of Main block elements</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Inert pair effect</li> <li>• Relative stability of different oxidation states</li> <li>• Diagonal relationship and anomalous behavior of Li and Mg</li> <li>• Allotropy and catenation</li> <li>• Structure, preparation and properties of some compounds</li> <li>• Clathrates</li> <li>• Preparation and properties of Xenon compounds</li> <li>• Applications</li> </ul>	
<b>Unit- IV: Fundamentals of Analytical Chemistry – I</b>	<b>12 hrs</b>
<p><b>Qualitative Analysis and Quantitative Analysis:</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of Quantitative Analysis: Gravimetric Analysis, Volumetric Analysis.</li> <li>• Solubility product</li> <li>• Common ion effect</li> <li>• H<sub>2</sub>S scheme, NH<sub>4</sub>Cl &amp; NH<sub>4</sub>OH scheme</li> <li>• Borax bead test, Charcoal test, Cobalt nitrate test &amp; Flame test</li> <li>• Separation of negative radical in presence of each other</li> </ul> <p><b>Modes of Concentration:</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Solution : Solvent, Solute</li> <li>• Determination of Molecular weight and eq. weight, Empirical formula</li> <li>• Different modes of concentration: Normality, Molarity, Molality, Mole fraction, % W/W, % W/V, % V/V, ppt, with numerical</li> </ul>	
<b>Unit- V: Fundamentals of Analytical Chemistry – II</b>	<b>14 hrs</b>
<p><b>Acid- Base &amp; Buffers</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Strong and weak electrolytes</li> <li>• Degree of ionization</li> <li>• Ionic product of water</li> <li>• Ionization of weak acid and weak base</li> <li>• pH scale</li> <li>• Salt hydrolysis</li> <li>• Calculation of hydrolysis constant &amp; degree of hydrolysis and pH of different salts</li> <li>• Chemistry of buffer</li> <li>• Determination of pH of Buffer by Henderson equation</li> </ul> <p><b>Acid- Base , Redox &amp; Non- aqueous Titrations</b></p>	

<ul style="list-style-type: none"> <li>• Introduction</li> <li>• <b>Acid – Base Titrations :</b> <ul style="list-style-type: none"> <li>➤ Weak acid v/s Strong base</li> </ul> </li> <li>• <b>Redox titration :</b> <ul style="list-style-type: none"> <li>➤ Oxalic acid – KMnO<sub>4</sub></li> <li>➤ Iodo &amp; Iodimetric</li> </ul> </li> <li>• <b>Non-aqueous Titrations:</b> <ul style="list-style-type: none"> <li>➤ Types</li> <li>➤ Application</li> </ul> </li> </ul>	
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### Pedagogic Tools:

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion

### Text Books:

1. Puri, B. R.; Sharma, L. R. & Kalia, K. C. (2017, 33<sup>rd</sup> edition) *Principles of Inorganic Chemistry*. New Delhi : Milestone (ISBN No. 978-8192143330).
2. Bahl, Arun; Bahl, B. S.; Tuli, G. D. (2020, 28<sup>th</sup> edition) *Essential of Physical Chemistry*. New Delhi : S. Chand (ISBN No.978-9352836093).

### Reference Books:

#### Inorganic Chemistry

1. Madan, R. L. (2011, 3<sup>rd</sup> edition) *Chemistry for degree student First year*. New Delhi: S. Chand (ISBN: 978-8121932301).
2. Lee, J. D. (2008, 5<sup>th</sup> edition) *Concise Inorganic Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 978-8126515547).
3. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller & Fraser Armstrong (2010, 5<sup>th</sup> edition) *Inorganic Chemistry*. Oxford: Oxford University Press (ISBN: 978-0-19-959960-8)

#### Analytical Chemistry

1. Douglas A. Skoog, West, Holler, Crouch (2004, 8<sup>th</sup> 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, 6<sup>th</sup> edition) *Analytical Chemistry*. Hoboken: Wiley-Blackwell Science Ltd. (ISBN: 978-81-265-1113-6).

### Suggested reading / E-resources:

1. <https://www.extension.harvard.edu/academics/courses/introduction-chemistry>

2. <https://libguides.reading.ac.uk/chemistry/e-resources>
3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5>
4. <http://library.iiti.ac.in/>

**Suggested MOOCs:**

1. [https://swayam.gov.in/nc\\_details/NPTEL](https://swayam.gov.in/nc_details/NPTEL)

**Methods of assessing the course outcomes**

Components of CIE: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 <sup>st</sup> 2 units	1 <sup>1/2</sup> hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			05	10
C	Class activity			05	
<b>Grand Total</b>					<b>30</b>
Assignment		<ul style="list-style-type: none"> <li>• Abstract and executive summary</li> <li>• Case study writing</li> <li>• Concept mapping</li> <li>• Student generated handbook</li> <li>• Essay writing etc...</li> </ul>			
Class activity		<ul style="list-style-type: none"> <li>• Presentation (PPT, Poster, Chart)</li> <li>• Seminar</li> <li>• Quiz</li> <li>• Model Making</li> <li>• Think Pair Share</li> <li>• Free writing</li> <li>• Class test</li> <li>• Debate/ Group Discussion</li> <li>• Open Book Test</li> <li>• Class test</li> </ul>			

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

<b>Discipline Specific Course- Core-2</b>		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: <b>Chemistry</b>	Offered to: <b>B.Sc. Chemistry</b>	
<b>Semester - I</b>		
Course Code	Course Title	Course Credit and Hours
<b>21UCHCC102</b>	<b>Introductory Organic and Physical Chemistry (F)</b>	<b>4 Credits - 4 hrs/wk</b>

**Course Description:**

This course provides a systematic study of the theories and principles of organic chemistry & Physical Chemistry. It includes nomenclature, structure, properties and reactions-mechanisms of organic compounds. It also covers concept of isomerization and stereochemistry. This course also deals with the core area of physical chemistry based around the themes of systems, states and processes. This course will also discuss the characteristics of the ideal gas, the concept of the ideal gas law, the behavior of gases under many different conditions. The course aims to address SDG No-4: Quality education.

**Course Purpose:**

This course aims to provide basic understanding of the core area of Organic chemistry and physical chemistry. This is designed in such a way that students will be able to understand the necessary background of carbon-containing compounds. Students will be able to analyze the properties and reactions of organic compounds. A good understanding of physical chemistry is important to students intending to complete a major or minor study in chemistry. This course is necessary to provide maturity and thinking ability of students which build up their career.

**Course Outcomes:** Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level (K <sub>1</sub> to K <sub>6</sub> )
CO <sub>1</sub>	Recognize the basic concept of organic chemistry for a chemical reaction.	K <sub>2</sub>
CO <sub>2</sub>	Distinguish between different kinds of isomers and Able to Predict the stereochemistry of organic compound.	K <sub>2</sub> ,K <sub>3</sub>
CO <sub>3</sub>	Remember nomenclature and understand the properties of organic compound.	K <sub>1</sub> , K <sub>2</sub>

CO <sub>4</sub>	Understand the principles of kinetics and mechanisms of surface reactions.	K2
CO <sub>5</sub>	Memorize gaseous laws and exploring the way solid, liquid and gases change under different situation.	K1, K3

Course Content	Hours
<b>Unit-I : Fundamentals of Organic Chemistry</b>	<b>12 hrs</b>
<p><b>Basics of Organic compounds</b></p> <ul style="list-style-type: none"> <li>• <b>Organic compounds:</b> <ul style="list-style-type: none"> <li>➤ Classification</li> <li>➤ Functional groups</li> <li>➤ Nomenclature</li> </ul> </li> <li>• <b>Hybridization</b></li> <li>• <b>Bond Fission :</b> <ul style="list-style-type: none"> <li>➤ Homolytic and heterolytic bond fission</li> <li>➤ Curly arrow rules</li> <li>➤ Nucleophile, Electrophile, Free Radical</li> </ul> </li> <li>• <b>Electronic Displacement Effects :</b> <ul style="list-style-type: none"> <li>➤ Inductive effect,</li> <li>➤ Electromeric effect</li> <li>➤ Resonance (Mesomeric) effect</li> <li>➤ Hyper conjugation</li> </ul> </li> <li>• <b>Reactive Intermediates:</b> <ul style="list-style-type: none"> <li>➤ Carbocation</li> <li>➤ Carbanion</li> <li>➤ Carbon free radical</li> </ul> </li> <li>• <b>Introduction to types of organic reactions:</b> <ul style="list-style-type: none"> <li>➤ Addition</li> <li>➤ Elimination</li> <li>➤ Substitution</li> <li>➤ Re-arrangement</li> </ul> </li> </ul>	
<b>Unit-II: Alkanes &amp; Cyclo alkanes</b>	<b>10 hrs</b>
<p><b>Alkanes</b></p> <ul style="list-style-type: none"> <li>• IUPAC nomenclature</li> <li>• Preparation <ul style="list-style-type: none"> <li>➤ Wurtz reaction</li> <li>➤ Kolbe Corey house</li> </ul> </li> <li>• Classification of Carbon atoms</li> </ul>	



<ul style="list-style-type: none"> <li>• Physical properties</li> <li>• Chemical properties</li>   <li>• Free radical substitution reaction</li> </ul> <p><b>Cyclo alkanes</b></p> <ul style="list-style-type: none"> <li>• Nomenclature</li> <li>• Methodes of preparation</li> <li>• Physical properties</li> <li>• Chemical properties</li> <li>• Bayer's stain theory</li> </ul>	
<b>Unit- III: Stereochemistry</b>	<b>12 hrs</b>
<p><b>Basics of Stereochemistry</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Classification</li> <li>• Isomerism</li> <li>• Chirality/Asymmetry</li> <li>• Meso Compounds</li> <li>• Enantiomer &amp; Diastereomer</li> <li>• Molecules with Two or more chiral centre</li> <li>• Optical activity &amp; Specific rotation</li> <li>• Racemic mixture &amp; Resolution</li> <li>• <b>Projection:</b> <ul style="list-style-type: none"> <li>➤ Wedge- Dash Formula</li> <li>➤ Fischer projection</li> <li>➤ Newmann</li> <li>➤ Sawhorse projection</li> </ul> </li> <li>• <b>Relative and Absolute configuration :</b> <ul style="list-style-type: none"> <li>➤ D/L Configuration</li> <li>➤ R/S Configuration &amp; CIP rules</li> </ul> </li> <li>• <b>Geometrical Isomerism:</b> <ul style="list-style-type: none"> <li>➤ Cis – Trans</li> <li>➤ Syn – Anti</li> <li>➤ E-Z</li> </ul> </li> <li>• <b>Conformational Analysis of alkanes:</b> <ul style="list-style-type: none"> <li>➤ Ethane</li> <li>➤ Butane</li> </ul> </li> </ul>	
<b>Unit- IV: Gaseous State &amp; Thermodynamics</b>	<b>12 hrs</b>

<p><b>Gaseous state</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• General characteristics of gases</li> <li>• Kinetic Molecular theory</li> <li>• Graham's law of diffusion</li> <li>• Deviation from ideal behavior</li> <li>• Vander Waal's equation</li> <li>• Method of Liquefaction of gases</li> <li>• Numericals</li> </ul> <p><b>Thermodynamics – 1</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• System, surrounding, types of system</li> <li>• Thermodynamic processes &amp; Macroscopic properties</li> <li>• State function &amp; Path function</li> <li>• Heat &amp; work</li> <li>• Zeroth law</li> <li>• First law</li> </ul> <p><b>Thermo chemistry :</b></p> <ul style="list-style-type: none"> <li>• Exothermic and endothermic reactions</li> <li>• <b>Heat of reaction:</b> Combustion, Solution, Neutralization, Vaporization, Sublimation, Transition</li> <li>• Hess law</li> </ul>	
<p><b>Unit- V: Surface chemistry</b></p>	<p><b>14 hrs</b></p>
<p><b>Surface Phenomena and Catalysis</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of Adsorption</li> <li>• Difference between Physisorption &amp; Chemisorption</li> <li>• <b>Adsorption isotherm</b> <ul style="list-style-type: none"> <li>➤ Langmuir Adsorption</li> <li>➤ Freundlich isotherm</li> </ul> </li> <li>• Applications</li> </ul> <p><b>Catalysis</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Types of catalyst &amp; catalysis</li> <li>• Characteristics of catalyst</li> <li>• Nobel catalyst</li> <li>• Loded catalyst</li> <li>• Formulated catalyst</li> </ul> <p><b>Basic Physical Properties</b></p>	

<ul style="list-style-type: none"> <li>• Introduction</li> <li>• <b>Classification of physical properties</b> : <ul style="list-style-type: none"> <li>➤ Additive property</li> <li>➤ Constitutive property</li> <li>➤ Additive - Constitutive property</li> </ul> </li> <li>• Surface tension</li> <li>• Dipole moment</li> <li>• Viscosity</li> </ul>	
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### Pedagogic Tools:

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion
- Seminar

### Text Books:

1. Bansal, Raj K. (2009, 5<sup>th</sup> edition) *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. (2009, 2<sup>nd</sup> edition) *Essential of Physical Chemistry*. New Delhi : S. Chand (ISBN No. 81-219-2978-4)

### Reference Books:

#### Organic Chemistry

1. Ahluwalia, V. K. (2011, 4<sup>th</sup>edition) *Organic Reaction Mechanism*. New Delhi: Narosa (ISBN: 978-81-8487-115-9).
2. T.W. Graham Solomons (2011, 10<sup>th</sup>edition) *Organic Chemistry*. Hoboken: John Willey & Sons (ISBN: 978-0-470-55659-7).
3. Clayden, Greeves, Warren & Wothers (2012, 2<sup>nd</sup> edition) *Organic Chemistry*. Oxford: Oxford University Press (ISBN: 9780199270293).

#### Physical Chemistry

1. Negi, A. S.; Anand, S. C. (2007, 2<sup>nd</sup>edition) *A Textbook of Physical Chemistry*. New Delhi: New age International Publisher (ISBN: 81-224-2005-0).
2. Peter Atkins; Julio de Paula (2018, 11<sup>th</sup> edition) *Atkin's Physical Chemistry*. Oxford: Oxford University Press (ISBN: 978-0198814740).
3. ArunBahl; B.S. Bahl (2009, 1<sup>st</sup>edition) *Numerical Problems in Physical Chemistry*. New Delhi: S. Chand (ISBN: 81-219-3084-7).

### Suggested reading / E-resources:

1. <https://www.extension.harvard.edu/academics/courses/introduction-chemistry>
2. <https://libguides.reading.ac.uk/chemistry/e-resources>
3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5>
4. <http://library.iiti.ac.in/>

**Suggested MOOCs:**

1. [https://swayam.gov.in/nc\\_details/NPTEL](https://swayam.gov.in/nc_details/NPTEL)

**Methods of assessing the course outcomes**

Components of CIE: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 <sup>st</sup> 2 units	1 <sup>1/2</sup> hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			05	10
C	Class activity			05	
Grand Total					30
Assignment		<ul style="list-style-type: none"><li>• Abstract and executive summary</li><li>• Case study writing</li><li>• Concept mapping</li><li>• Student generated handbook</li><li>• Essay writing etc...</li></ul>			
Class activity		<ul style="list-style-type: none"><li>• Presentation (PPT, Poster, Chart)</li><li>• Seminar</li><li>• Quiz</li><li>• Model Making</li><li>• Think Pair Share</li><li>• Free writing</li><li>• Class test</li><li>• Debate/ Group Discussion</li><li>• Open Book Test</li><li>• Class test</li></ul>			

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

<b>Discipline Specific Course- Core Practical-1</b>		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: <b>Chemistry</b>	Offered to: <b>B.Sc. Chemistry</b>	
<b>Semester - I</b>		
Course Code	Course Title	Course Credit and Hours
<b>21UCHCC103</b>	<b>Combined Practical</b>	<b>4 Credits - 12 hrs/wk</b>

**Course Description:**

This course contains important aspects of qualitative analysis as well as quantitative analysis in chemistry through experiments. It provides the analysis of basic physical properties of various organic and inorganic compounds. The courses illustrate study of calibration of instrument and volumetric glassware, preparation & standardization of analytical solutions, volumetric analysis along with gravimetric Analysis. The course aims to address SDG No-4& 9: Quality education& Industry, innovation and Infrastructure.

**Course Purpose:**

The general intention of the practical course is that the students will get familiar with experimental procedures in a chemical laboratory. This course is outline in such a way that students will be capable to accomplish various types of Volumetric Analysis and Gravimetric Analysis. Student will learn many experimental techniques and they will be capable to observe the experiments, by which they can write accurate analysis and results. Students will be proficient to quantify and analyze various physical properties of organic and inorganic compounds. This course is necessary to provide the practical knowledge and laboratory techniques to students in the field of chemistry.

**Course Outcomes:** Upon completion of this course, the learner will be able to

<b>CO No.</b>	<b>CO Statement</b>	<b>Blooms taxonomy Level (K<sub>1</sub> to K<sub>6</sub>)</b>
CO <sub>1</sub>	Identify one cation and anion in a given unknown inorganic salt and record observation and write laboratory reports according to disciplinary standards.	K1
CO <sub>2</sub>	Built ability for summarization and determination of basic physical properties.	K2
CO <sub>3</sub>	Illustrate scientific skills in understanding, planning and preparing various organic reagents and solutions.	K1
CO <sub>4</sub>	Understanding the scientific methods for calibration of the glassware's and instruments.	K2, K3
CO <sub>5</sub>	Understanding, planning and performing experiments for preparation and standardization of analytical solutions.	K2, K3

Course Content	Hours
<b>Analytical chemistry (15 – 17 experiment)</b>	
<ul style="list-style-type: none"> <li>➤ Calibration of Volumetric Glassware-Burette, pipette, measuring flask, measuring cylinder, etc.</li> <li>➤ Preparation of Solution: <ul style="list-style-type: none"> <li>• Saturated sodium bicarbonate</li> <li>• 20% NaOH</li> <li>• 50% HCl</li> </ul> </li> <li>➤ Preparation &amp; Standardization of Analytical Solution:- <ul style="list-style-type: none"> <li>• To prepare and standardize 0.1 N NaOH solution using 0.1 N succinic acid solution.</li> <li>• To prepare and standardize 0.1 M HCl solution using anhydrous sodium carbonate.</li> <li>• To prepare and standardize 0.02 M KMnO<sub>4</sub> solution using f 0.1 N Oxalic acid.</li> <li>• To prepare and standardize 0.01 N iodine solution using 0.01 N Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.5H<sub>2</sub>O solution.</li> </ul> </li> <li>➤ <b>Volumetric analysis:-</b></li> <li>➤ <b><u>Acidimetry and alkalimetry:-</u></b> <ul style="list-style-type: none"> <li>• To determine Normality, Molarity and g/liter of xN NaOH by using 0.1N HCl solution.</li> <li>• To determine Normality, Molarity and g/liter of NaOH and HCl by using 0.05 M Na<sub>2</sub>CO<sub>3</sub> solution.</li> <li>• To determine Normality, Molarity and g/liter of each component in a given mixture of NaHCO<sub>3</sub> and Na<sub>2</sub>CO<sub>3</sub> by using 0.1 M HCl solution.</li> </ul> </li> <li>➤ <b><u>Redox titrations:-</u></b> <ul style="list-style-type: none"> <li>• To determine Normality, Molarity and g/liter of each component in a given mixture of H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>.2H<sub>2</sub>O and H<sub>2</sub>SO<sub>4</sub> by using 0.02 M KMnO<sub>4</sub> and 0.1 M NaOH solution.</li> <li>• To determine Normality, Molarity and g/liter of each component in a given mixture of H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>.2H<sub>2</sub>O and K<sub>2</sub>C<sub>2</sub>O<sub>4</sub>.H<sub>2</sub>O by using 0.02 M KMnO<sub>4</sub> and 0.1 M NaOH solution.</li> <li>• To determine Normality, Molarity and g/liter of KMnO<sub>4</sub> and FeSO<sub>4</sub>.7H<sub>2</sub>O by using 0.05 M H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>.2H<sub>2</sub>O solution.</li> <li>• To determine Normality, Molarity and g/liter of FeSO<sub>4</sub> (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>.6H<sub>2</sub>O and K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> by using 0.02 M KMnO<sub>4</sub> solution.</li> </ul> </li> <li>➤ <b><u>Iodometric:-</u></b> <ul style="list-style-type: none"> <li>• To determine amount of Cu<sup>+2</sup> in the given solution of CuSO<sub>4</sub>.5H<sub>2</sub>O using 0.05 N Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.5H<sub>2</sub>O by Iodometric titration.</li> <li>• To determine amount of glucose in the given solution of glucose using 0.1 N Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.5H<sub>2</sub>O by Iodometric titration.</li> </ul> </li> <li>➤ <b><u>Iodimetric:-</u></b> <ul style="list-style-type: none"> <li>• To determine amount of As<sup>+3</sup> in the given solution of As<sub>2</sub>O<sub>3</sub> using</li> </ul> </li> </ul>	

<p>0.05 N <math>\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}</math> by Iodimetric titration.</p> <ul style="list-style-type: none"> <li>To determine %W/V of iodine and potassium iodide in given sample mixture.</li> </ul> <p>➤ <b><u>Non- aqueous titration:-</u></b></p> <ul style="list-style-type: none"> <li>To determine concentration of organic acid into given solution.</li> <li>To prepare 0.1 N perchloric acid and standardize it.</li> </ul> <p>➤ <b><u>Gravimetric Analysis – Weight loss on Heating:-</u></b></p> <ul style="list-style-type: none"> <li>To determine loss in weight per gram and calculate the percentage purity of the given sample of <math>\text{MgCO}_3/\text{ZnCO}_3</math>.</li> <li>To determine loss in weight per gram and calculate the percentage purity of the given sample of <math>\text{BaCl}_2 \cdot 2\text{H}_2\text{O}</math>.</li> <li>To determine loss in weight per gram and calculate the percentage purity of the given sample of <math>\text{NaHCO}_3</math>.</li> </ul>	
<b>Inorganic chemistry (10 – 12 experiment)</b>	
<p>➤ To perform Inorganic qualitative analysis of given unknown salt – Two Radicals</p> <ul style="list-style-type: none"> <li><math>\text{Na}^+</math>, <math>\text{K}^+</math>, <math>\text{NH}_4^+</math>, <math>\text{Cu}^{+2}</math>, <math>\text{Cl}^-</math>, <math>\text{Br}^-</math>, <math>\text{I}^-</math>, <math>\text{NO}_2^-</math>, <math>\text{NO}_3^-</math>, <math>\text{Cr}_2\text{O}_7^{-2}</math>, <math>\text{CrO}_4^{-2}</math>, <math>\text{CO}_3^{-2}</math>,</li> </ul>	
<b>Organic Chemistry (12 – 15 experiment)</b>	
<p>➤ Preparation of Organic Reagents: Tollen's reagent, Neutral <math>\text{FeCl}_3</math>, Sod. Cobaltnitrite solution etc.....</p> <p>➤ To perform Organic qualitative analysis of given unknown organic substance</p> <ul style="list-style-type: none"> <li>✓ Benzoic acid</li> <li>✓ Cinnamic acid</li> <li>✓ <math>\alpha</math>-naphthol</li> <li>✓ <math>\beta</math>-naphthol</li> <li>✓ Resorcinol</li> <li>✓ <math>\alpha</math>-naphthyl amine</li> <li>✓ m-dinitro benzene</li> <li>✓ Urea</li> <li>✓ Benzamide</li> <li>✓ Acetanilide</li> <li>✓ Benzanilide</li> <li>✓ Naphthalene</li> <li>✓ Di phenyl amine</li> <li>✓ Anthracene</li> <li>✓ Pthalic acid</li> </ul>	
<b>Physical Chemistry (12-15 experiment)</b>	
<p>➤ Calibration of Instruments</p> <ul style="list-style-type: none"> <li>• Thermometer</li> <li>• Viscometer</li> <li>• Stalaganometer</li> </ul>	

➤ Determination of Basic Physical Properties:

• **Surface tension – Parachor:-**

- ✓ Find out the surface tension of liquid A, B and C by drop-weight method. Find the value of Parachor of liquids and CH<sub>2</sub> group.
- ✓ Find out the surface tension of NaCl solution, glucose solution and water by drop-weight method and compare the effect of electrolytes on these solutions.
- ✓ To determine the critical micelle concentration (CMC) of given surface active agent (SLS) using stalagnometer.
- ✓ To study the effect of temperature on surface tension of water.

• **Viscosity:-**

- ✓ To determine relative and absolute viscosity of pure liquid A, B, C & D by Ostwald's viscometer.
- ✓ To determine relative and absolute viscosity of pure liquid 10%, 5%, 2.5% and unknown by Ostwald's viscometer.
- ✓ To determine the effect of temperature on viscosity of given glycerin.

• **Adsorption:-**

- ✓ To determine the rate of adsorption of given organic acid using activated charcoal.
- ✓ To investigate the adsorption of oxalic acid by activated charcoal and prove the validity of Freundlich and Langmuir adsorption isotherm.
- ✓ To study comparative study of adsorption capacity of various adsorbents.
- To determine Density with help of hydrometer.

➤ **Thermodynamics:-**

- To calculate entropy of vaporization of a given liquid by plotting a graph of  $\log(1/\text{time})$  vs.  $\log(1/\text{temp.})$ 
  - ✓ Benzene
  - ✓ n-Hexane
- To determine solubility of benzoic acid and find out the heat of solution at room temperature and 40°C temperature by using N/50 NaOH solution.
- To study the effect of surface area of the rate of evaporation of D.W.
- To study of concentration of NaCl solution on the rate of evaporation.



**Pedagogic Tools:**

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion
- Seminar

**Text books:**

1. Brian S. Furniss (1989, 5<sup>th</sup>edition) *Vogel's Textbook of Practical Organic Chemistry*. Hoboken: John Wiley & Sons (ISBN: 0-582-462363).

**Reference books:**

2. Hassner, A. (2012, 3<sup>rd</sup>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, 5<sup>th</sup> edition) *Vogel's Textbook of Quantitative Chemical Analysis*. Hoboken: John Wiley & Sons (ISBN: 0-582-44693-7).
4. Jerry R. Mohrig (2010, 3<sup>rd</sup>edition) *Techniques in Organic chemistry*. London: W. H. Freeman & Company (ISBN: 1-4292-1956-4).
5. Svehla, G. (1979, 5<sup>th</sup>edition) *Textbook of macro and semi micro qualitative analysis*. London: Logman Publishing group (ISBN: 0-582-44367-9).

**Suggested reading / E-resources:**

1. <https://www.extension.harvard.edu/academics/courses/introduction-chemistry>
2. <https://libguides.reading.ac.uk/chemistry/e-resources>
3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5>
4. <http://library.iiti.ac.in/>

**Suggested MOOCs:**

1. [https://swayam.gov.in/nc\\_details/NPTEL](https://swayam.gov.in/nc_details/NPTEL)

**Methods of Assessment & Tools:**

Components of CIE: 40marks

Sr. No	CIA Component	Content	Duration	Marks	Total Marks
1	Test	After Completion of all Assessable Experiments	6 hrs	60 marks (2 Exercise of 30 marks)	30
2.	Observation book & Record	-	-	10	10
<b>Total</b>					<b>40</b>

Note : Any other assessment tools or methods can be adopted as per requirement of the course.