

B.SC CHEMISTRY SYLLABUS UNDER CBCS w.e.f. 2023-24

B.Sc. Chemistry Theory I Year (Semester –I)

DSC–I (BS106) - Chemistry - I

Total periods	60
Theory 4 Hours/Week	4 credits
Practical 3 Hours/Week	1 credit

Unit-I (Inorganic Chemistry)

15 h (1hr/week)

S1- I-1. Chemical Bonding

8 h

Ionic solids- lattice and solvation energy, solubility of ionic solids, Fajan's rule, polarity and polarizability of ions. VSPER Theory - Common hybridization- sp , sp^2 , sp^3 , sp^3d , sp^3d^2 and sp^3d^3 , shapes of molecules. Molecular orbital theory: Shapes and sign convention of atomic orbitals. Modes of bonds. Criteria for orbital overlap. LCAO concept. Pi (π) and sigma (σ) overlapping. Concept of Types of molecular orbitals- bonding, antibonding and non-bonding. MOED of homonuclear diatomics - H_2 , N_2 , O_2^- , O_2^{2-} , F_2 (unhybridized diagrams only) and heteronuclear diatomics CO , CN^- , NO , NO^+ and HF . Bond order, stability and magnetic properties.

S1-I-2. P-Block Elements 1

7 h

Group-13: Structure of diborane and higher Boranes (B_4H_{10} and B_5H_9), Boron nitrogen compounds ($B_3N_3H_6$ and BN), Lewis acid nature of BX_3 . Group - 14: Carbides-Classification - ionic, covalent, interstitial - Structures and reactivity. Industrial applications. Silicones - Classification - straight chain, cyclic and cross-linked. Group - 15: Nitrides - Classification - ionic, covalent and interstitial. Reactivity - hydrolysis. Reactions of hydrazine, hydroxyl amine, phosphazenes.

Unit – II (Organic Chemistry)

15h (1 hr/week)

S1-O-1: Structural Theory in Organic Chemistry

5 h

Bond polarization: Factors influencing the polarization of covalent bonds, electro negativity - inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance - Mesomeric effect, application to (a) acidity of phenol. (b) acidity of carboxylic acids and basicity of anilines. Stability of carbo cations, carbanions and free radicals. Hyper conjugation and its application to stability of carbonium ions, free radicals and alkenes.

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S1-O-2: Acyclic Hydrocarbons

6 h

Alkanes- Methods of preparation: From Grignard reagent, Kolbe synthesis. Chemical reactivity- inert nature, free radical substitution, Halogenations example- reactivity, selectivity and orientation.

Alkenes - Preparation of alkenes (with mechanism) (a) by dehydration of alcohols (b) Dehydro halogenations of alkyl halides (c) by dehalogenation of 1,2 dihalides, Zaitsev's rule. Properties: Anti-addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H₂O, HOX, H₂SO₄ with mechanism and addition of HBr in the presence of peroxide (anti-Markonikov's addition). Oxidation (cis-additions) -hydroxylation by KMnO₄, OsO₄, anti addition- peracids (via epoxidation), hydroboration, ozonolysis - location of double bond. Dienes - Types of dienes, reactions of conjugated dienes - 1,2 and 1,4 addition of HBr to 1,3 - butadiene and Diels - Alder reaction.

Alkynes- Preparation by dehydrohalogenation of vicinal dihalides, dehalogenation of tetrahalides. Physical Properties: Chemical reactivity - electrophilic addition of X₂, HX, H₂O (tautomerism). Oxidation (formation of enediol, 1,2 diones and carboxylic acids) and reduction (Metal-ammonia reduction, catalytic hydrogenation).

S1-O-3: Aromatic Hydrocarbons

4h

Introduction to aromaticity: Huckel's rule - Benzene, Naphthalene and Anthracene. Reactions - General mechanism of electrophilic substitution, mechanism of nitration, sulphonation and halogenation. Friedel Craft's alkylation and acylation. Orientation of aromatic substitution - Definition of ortho, para, and meta directing groups. Ring activating and deactivating groups with examples. Orientation - (i) activating groups: Amino, methoxy and alkyl groups. (ii) Deactivating groups - nitro, nitrile, carbonyl, carboxylic acid, sulphonic acid and halogroups.

Unit - III (Physical Chemistry)

15h (1 hr/week)

S1-P-1: Atomic structure and elementary quantum mechanics

3 h

Black body radiation, heat capacities of solids, Rayleigh Jeans law, Planck's radiation law, photoelectric effect, Limitations of classical mechanics, Compton effect, De Broglie's hypothesis. Heisenberg's uncertainty principle.

S1-P-2: Gaseous State

5h

Deviation of real gases from ideal behavior. van der Waals equation of state. Critical phenomenon. PV isotherms of real gases, continuity of state. Andrew's isotherms of CO₂. The van der Waal's equation and critical state. Derivation of relationship between critical constants and van der Waal's constants. The law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Liquifaction of gases: i) Linde's method based on Joule Thomson effect ii) Claude's method based on adiabatic expansion of a gas.

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S1-P-3: Liquid State and Solutions

4 h

Liquid State

Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Solutions

3 h

Liquid - liquid mixtures, ideal liquid mixtures, Raoult's and Henry's laws. Non ideal systems. Azeotropes: HCl-H₂O and C₂H₅OH - H₂O systems. Fractional distillation. Partially miscible liquids: Phenol - Water, Trimethyl amine - Water and Nicotine - Water systems.

Unit - IV (General Chemistry)

15h (1 hr/week)

S1-G-1. General Principles of Inorganic Qualitative Analysis

6 h

Anion analysis: Theory of sodium carbonate extract, classification and reactions of anions- CO_3^{2-} , Cl^- , Br^- , SO_4^{2-} , PO_4^{3-} , BO_3^{3-} , CH_3COO^- , NO_3^- . Interfering ions. Cation Analysis: Principles involved Solubility product, common ion effect, general discussion for the separation and identification of group I individual cations (Hg_2^{2+} , Ag^+ , Pb^{2+}) with flow chart and chemical equations. Principle involved in separation of group II & IV cations. General discussion for the separation and identification of group II (Hg^{2+} , Pb^{2+} , Bi^{3+} , Cd^{2+} , Sb^{3+}), III (Al^{3+} , Fe^{3+}), IV (Mn^{2+} , Zn^{2+}) individual cations with flow chart and chemical equations. General discussion for the separation and identification of group V individual cations (Ba^{2+} , Sr^{2+} , Ca^{2+}) with flow chart and chemical equations. Theory of flame test. Identification of Group VI cations (Mg^{2+} , NH_4^+).

S1-G-2. Isomerism

5 h

Isomerism: Definition of isomers. Classification of isomers: Constitutional and Stereoisomers - definition and examples. Constitutional isomers: chain, functional and positional isomers. Stereoisomers: enantiomers and diastereomers - definitions and examples. Representation of stereoisomers - Wedge, Fischer projection, Sawhorse, Newmann formulae.

Conformational analysis : Classification of stereoisomers based on energy. Definition and examples Conformational and configurational isomers. Conformational analysis of ethane, n- butane, 1,2-dichloroethane, 2-chloroethanol. Cyclic compounds: Baeyer's strain theory, Conformational analysis of cyclohexane

Cis-trans isomerism: E-Z-Nomenclature

S1-G-3: Solid state Chemistry

4h

Laws of Crystallography: (i) Law of Constancy of interfacial angles (ii) Law of Symmetry-Symmetry elements in crystals (iii) Law of rationality of indices. Definition of space lattice, unit cell. Bravais Lattices and Seven Crystal systems (a brief review). X-ray diffraction by crystals; Derivation of Bragg's equation. Determination of structure of NaCl, KCl and CsCl (Bragg's method and Powder method).

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References

General reference: B.Sc I Year Chemistry : Semester I, Telugu Academy publication, Hyd

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1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A. Cotton, G. Wilkinson and Paul L. Gaus 3rd edn Wiley Publishers 2001. Chem.
4. Inorganic Chemistry Principles of structure and reactivity by James E. Huhey, E.A. Keiter and R.L. Keiter 4th edn.
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9. Organic Chemistry by C N Pillai

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1. Principles of physical chemistry by Prutton and Marron.
2. Text Book of Physical Chemistry by Soni and Dharmahara..
3. Text Book of Physical Chemistry by Puri and Sharma.
4. Text Book of Physical Chemistry by K. L. Kapoor.
5. Physical Chemistry through problems by S.K. Dogra.
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry by Lewis Glasstone.

Unit IV

1. Qualitative analysis by Welcher and Hahn.
2. Vogel's Qualitative Inorganic Analysis by Svehla.
3. Text Book of Organic Chemistry by Morrison and Boyd.
4. Text Book of Organic Chemistry by Graham Solomons.
5. Text Book of Organic Chemistry by Bruce Yuranis Powla.
6. Text Book of Organic Chemistry by Soni.
7. Text Book of Physical Chemistry by Soni and Dharmahara..
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B.Sc. CHEMISTRY SYLLABUS UNDER CBCS w.e.f. 2023-24
Chemistry Practical Syllabus for I Semester

Core paper-1
Qualitative Analysis - Semi micro analysis of mixtures

Instructions: 3hr per week

No of Credits: 1

Laboratory Course

45h (3 h /week)

Paper I - Qualitative Analysis – Greener and safer analysis of mixtures

Analysis of two anions (one simple, one interfering) and two cations in the given mixture using groove tile

Anions: CO_3^{2-} , Cl^- , Br^- , I^- , CH_3COO^- , NO_3^- , SO_4^{2-} ..

Cations:

Pb^{2+}

Bi^{3+} , Cd^{2+} , Cu^{2+}

Al^{3+} , Fe^{3+}

Zn^{2+} , Ni^{2+} , Co^{2+} , Mn^{2+}

Ba^{2+} , Ca^{2+}

Mg^{2+} , NH_4^+

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B.SC CHEMISTRY SYLLABUS UNDER CBCS w.e.f. 2023-24

B.Sc. Chemistry Theory I Year (Semester –II)

DSC–II (BS 206)- Chemistry - II

Total periods	60
Theory 4 Hours/Week	4 credits
Practical 3 Hours/Week	1 credit

Unit-I (Inorganic Chemistry)

15 h (1hr/week)

S2-I-1 P-block Elements-II

7 h

Oxides: Types of oxides (a) Normal- acidic, basic amphoteric and neutral (b) Mixed (c) sub oxide (d) peroxide (e) superoxide. Structure of oxides of C, N, P, S and Cl - reactivity, thermal stability, hydrolysis.

Oxy acids: Structure and acidic nature of oxy acids of B, C, N, P, S, Cl and I. Redox properties of oxy acids of Nitrogen: HNO_2 (reaction with FeSO_4 , KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$), HNO_3 (reaction with H_2S , Cu), HNO_4 (reaction with KBr, Aniline), $\text{H}_2\text{N}_2\text{O}_2$ (reaction with KMnO_4). Redox properties of oxy acids of Phosphorus: H_3PO_2 (reaction with HgCl_2), H_3PO_3 (reaction with AgNO_3 , CuSO_4). Redox properties of oxy acids of Sulphur: H_2SO_3 (reaction with KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$), H_2SO_4 (reaction with Zn, Fe, Cu), $\text{H}_2\text{S}_2\text{O}_3$ (reaction with Cu, Au), H_2SO_5 (reaction with KI, FeSO_4), $\text{H}_2\text{S}_2\text{O}_8$ (reaction with FeSO_4 , KI). Redox properties of oxy acids of Chlorine.

Interhalogens- Classification- general preparation- structures of AB , AB_3 , AB_5 and AB_7 types and reactivity.

Poly halides- Definition and structure of ICl_2^- , ICl_4^- and I_3 .

Pseudohalogens: Comparison with halogens.

S2-I-2: Chemistry of Zero group elements

2 h

Isolation of noble gases, Structure, bonding and reactivity of Xenon compounds – Oxides, Halides and Oxy-halides. Clathrate compounds and Anomalous behavior of He (II)

S2-I-3: Chemistry of d-block elements

6 h

Characteristics of d-block elements with special reference to electronic configuration, variable valence, ability to form complexes, magnetic properties & catalytic properties. Stability of various oxidation states and standard reduction potentials. Comparative treatment of second and third transition series with their 3d analogues. Study of Ti, Cr and Cu triads. Titanium triad – electronic configuration and reactivity of +3 and +4 states – oxides and halides. Chromium triad – reactivity of +3 and +6 states. Copper triad – reactivity of +1, +2 and +3 states.

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Unit – II (Organic Chemistry)

15h(1 hr/week)

S2-O-1: Halogen compounds

4 h

Classification: alkyl (primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl. Chemical reactivity- reduction, formation of RMgX , Nucleophilic substitution reactions – classification into SN_1 and SN_2 . Mechanism and energy profile diagrams of SN_1 and SN_2 reactions. Stereochemistry of SN_2 (Walden Inversion) 2-bromobutane, SN_1 (Racemisation) 1-bromo-1-phenylpropane Structure and reactivity – Ease of hydrolysis - comparison of alkyl, vinyl, allyl, aryl, and benzylhalides.

S2-O-2: Hydroxy compounds and ethers

6 h

Alcohols: Preparation: 1° , 2° and 3° alcohols using Grignard reagent, Reduction of Carbonyl compounds, carboxylic acids and esters. Physical properties: H-bonding, Boiling point and Solubility. Reactions with Sodium, HX/ZnCl_2 (Lucas reagent), esterification, oxidation with PCC, alk. KMnO_4 , acidic dichromates, conc. HNO_3 and Oppenauer oxidation (Mechanism).

Phenols: Preparation: (i) from diazonium salts of anilines, (ii) from benzene sulphonic acids and (iii) Cumene hydroperoxide.

Properties: Acidic nature, formation of phenoxide and reaction with R-X, electrophilic substitution; halogenations, Reimer Tiemann reaction (Mechanism), Kolbe reaction (Mechanism), Gattermann-Koch reaction, Azo-coupling reaction, Schotten-Boumann reaction, Houben-Hoesch condensation, .

Ethers: Nomenclature, preparation by (a) Williamson's synthesis (b) from alkenes by the action of conc. H_2SO_4 . Physical properties – Absence of Hydrogen bonding, insoluble in water, low boiling point. Chemical properties – inert nature, action of conc. H_2SO_4 and HI.

S2-O-3. Carbonyl compounds

5h

Preparation of aldehydes & ketones from acid chloride, 1,3-dithianes, nitriles and from carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by (a) Oxidation of arenes (b) Hydrolysis of benzal halides Physical properties – absence of Hydrogen bonding. Reactivity of the carbonyl groups in aldehydes and ketones. Chemical reactivity: Addition of (a) NaHSO_3 (b) HCN (c) RMgX (d) NH_3 (e) RNH_2 (f) NH_2OH (g) PhNHNH_2 (h) 2,4-DNP (Schiff bases). Addition of H_2O to form hydrate, chloral hydrate (stable), addition of alcohols - hemiacetal and acetal formation. Cannizzaro reaction. Oxidation reactions – KMnO_4 oxidation and auto oxidation, reduction – catalytic hydrogenation, mechanism of Clemmenson's reduction, Wolf-Kishner reduction, Meerwein Ponnoff-Verly reduction. Reduction with LAH, NaBH_4 .

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Unit – III (Physical Chemistry)

15h(1hr/week)

S2-P-1: Electrochemistry

15 h

Electrical transport – conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution. Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law - its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method for attackable electrodes. Applications of conductivity measurements: Determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells. Electro motive force (EMF) of a cell and its measurement. Computation of EMF. Types of reversible electrodes- the gas electrode, metal-metal ion, metal-insolublesalt and redox electrodes. Electrode reactions, Nernst equation, cell EMF and Single electrode potential, Standard Hydrogen electrode – reference electrodes (calomel electrode)– standard electrode potential, sign conventions, electrochemical series and its significance. Applications of EMF measurements. Calculation of thermodynamic quantities of cell reactions (Gibbs free energy G , Helmholtz free energy and Equilibrium constant K). Determination of pH using hydrogen electrode, glass electrode and quinhydrone electrode. Solubility product of AgCl. Potentiometric titrations.

Unit – IV (General Chemistry)

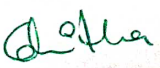
15 h (1hr/week)


S2-G-1: Theory of Quantitative Analysis


6 h

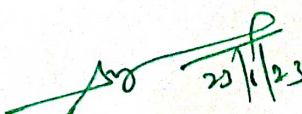
Volumetric Analysis: Introduction, standard solutions, indicators, end point, titration curves, Types of titrations: i) neutralization titration- principle, theory of acid base indicators, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid- strong base and weak acid –weak base. Theory of redox titrations – internal ($KMnO_4$) and external indicators – use of diphenylamine and ferroin indicators. Theory of complexometric titrations – use of EBT, Murexide and Fast sulphone black indicators. Role of pH in complexometric titrations. Precipitation titrations – theory of adsorption indicators.

Gravimetric analysis- Introduction, nucleation, precipitation, growth of precipitate, filtration and washing, drying and incineration of precipitate, coprecipitation and post precipitation. Determination of Ni^{2+}


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S2-G-2: Stereoisomerism

5 h

Optical activity: Definition, wave nature of light, plane polarised light, optical rotation and specific rotation, chiral centers. Chiral molecules: definition and criteria- absence of plane, center and S_n axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans- 1,2-dichlorocyclopropane). Molecules with constitutionally symmetrical chiral carbons (Tartaric acid) Molecules with constitutionally unsymmetrical chiral carbons (2,3-dibromopentane). D, L configuration – examples. R, S – configuration: Cahn-Ingold-Prelog rules, examples for asymmetric and dissymmetric molecules.

S2-G-3: Dilute Solutions & Colligative Properties

4h

Dilute Solutions, Colligative Properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis - laws of osmotic pressure, its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point.

References

General reference: B.Sc I Year Chemistry : Semester II, Telugu Academy publication, Hyd

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7. E.A. Keiter and R.L. Keiter 4th Edn.
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Unit III

1. Physical chemistry by P Watkins
2. Principles of physical chemistry by Prutton and Marron.
3. Text Book of Physical Chemistry by Soni and Dharmahara.
4. Text Book of Physical Chemistry by Puri and Sharma
5. Text Book of Physical Chemistry by K. L. Kapoor
6. Physical Chemistry through problems by S.K. Dogra.
7. Elements of Physical Chemistry by Lewis and Glasstone.
8. Material science by Kakani & Kakani

Unit IV

1. Vogel's Text Book of Quantitative Analysis by G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney 5th edn Addison Wesley Longman Inc. 1999.
2. Quantitative Analysis by Day and Underwood Prentice Hall (India) VI Edn..
3. Nano: The Essentials by T. Pradeep, McGraw-Hill Education.
4. Chemistry of nanomaterials: Synthesis, Properties and applications by CNR Rao et al.
5. Nanostructured Materials and Nanotechnology, edited by Hari Singh Nalwa, Academic Press
6. Practical chemistry by V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati.

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B.Sc. CHEMISTRY SYLLABUS UNDER CBCS w.e.f. 2023-24
Chemistry Practical Syllabus for II Semester
Core paper-II

Quantitative Analysis Acid - Base titrations

Instructions: 3hr per week

No of Credits: 1

Laboratory Course

45hrs (3 h /week)

Paper II

Quantitative Analysis

Acid - Base titrations

1. Estimation of Carbonate in Washing Soda.
2. Estimation of Bicarbonate in Baking Soda.
3. Estimation of Carbonate and Bicarbonate in the Mixture.

Redox Titrations

1. Determination of Fe(II) using $K_2Cr_2O_7$
2. Determination of Fe(II) using $KMnO_4$ with sodium oxalate as primary standard.
3. Determination of Cu(II) using $Na_2S_2O_3$ with $K_2Cr_2O_7$ as primary standard

Complexometric Titrations

1. Estimation of Mg^{2+}
2. Estimation of Cu^{2+}

Demonstration of Greener approach methodology in the volumetric analysis of oxalic acid/Mohr's salt vs $KMnO_4$.

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GOVT DEGREE COLLEGE FOR WOMEN (A), NALGONDA
DEPARTMENT OF CHEMISTRY

Course Outcomes of B.Sc. in Chemistry Programme AY 2023-24

COURSE OUTCOMES: B. SC. CHEMISTRY

SEMESTER-I, PAPER 1 (Chemistry -I) 4 CREDITS

(As per CBCS syllabus With Effect from the Academic Year 2023-2024)

THEORY	
CO 1	The student be able to understand the chemical bonding and molecular geometry of molecules
CO 2	The student be able to understands the importance of basics of organic molecule, bonding, reactivity and mechanisms.
CO 3	The student understands the reaction intermediates, resonance, and reactivity along the reaction pathways.
CO 4	The student be able to understand atomic theory, various states of the matter and the laws related to describe the states
PRACTICALS	
CO 1	Student be able to identify the ions (cations and anions) present in any mixture
CO 2	Student be able to understand the techniques involved in the semi micro analysis

SEMESTER-II, PAPER 2 (Chemistry - II) 4 CREDITS

(As per CBCS syllabus With Effect from the Academic Year 2023-2024)

THEORY	
CO 1	Able to understand the structure, reactivity and properties of p-block, zero group and d-block elements.
CO 2	Able to Understand the structure, preparation and properties of halogen, hydroxyl and carbonyl compounds
CO 3	Able to determine the EMF of a cell through potentiometry
CO 4	Able to understand the applications of volumetric and gravimetric analysis
CO 5	Able to predict the chirality and configuration of organic molecules
CO 6	Able to evaluate molecular weight of the solute through colligative properties
PRACTICALS	
CO 1	Student is able to explain the principle involved in the acid-base, redox and complexometric titrations
CO 2	Demonstrate the <i>greenex approach method of Volumetric Analysis</i>

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