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## **Rationale**

Higher Secondary is the most crucial stage of school education because at this juncture specialized discipline based, content-oriented courses are introduced. Students reach this stage after 10 years of general education and opt for Chemistry with a purpose of pursuing their career in basic sciences or professional courses like medicine, engineering, technology and study courses in applied areas of science and technology at tertiary level. Therefore, there is a need to provide learners with sufficient conceptual background of Chemistry, which will make them competent to meet the challenges of academic and professional courses after the higher secondary stage.

The new and updated curriculum is based on disciplinary approach with rigour and depth taking care that the syllabus is not heavy and at the same time it is comparable to the international level. The knowledge related to the subject of Chemistry has undergone tremendous changes during the past one decade. Many new areas like synthetic materials, bio-molecules, natural resources, industrial chemistry are coming in a big way and deserve to be an integral part of chemistry syllabus at senior secondary stage

At international level, new formulations and nomenclature of elements and compounds, symbols and units of physical quantities floated by scientific bodies like IUPAC and CGPM are of immense importance and need to be incorporated in the updated syllabus. The revised syllabus takes care of all these aspects. Greater emphasis has been laid on use of new nomenclature, symbols and formulations, teaching of fundamental concepts, applications of concepts in chemistry to industry/technology, logical sequencing of units, removal of obsolete content and repetition etc.

The broad objectives of teaching Chemistry at Senior Secondary Stage are to help the learners:

- to promote understanding of basic facts and concepts in chemistry while retaining the excitement of chemistry.
- to make students capable of studying chemistry in academic and professional courses (such as medicine, engineering, technology) at tertiary level.
- to expose the students to various emerging new areas of chemistry and apprise them with their relevance in their future studies and their application in various spheres of chemical sciences and technology.
- to equip students to face various changes related to health, nutrition, environment, population, weather, industries and agriculture.
- to develop problem solving skills in students.
- to expose the students to different processes used in industries and their technological applications.
- to apprise students with interface of chemistry with other disciplines of science such as physics, biology, geology, engineering etc.
- to acquaint students with different aspects of chemistry used in daily life.
- to develop an interest in students to study chemistry as a discipline.

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**Class XII (Theory)****One Paper Time: 3 Hours, 70 marks**

<b>Unit</b>	<b>Title</b>	<b>Marks</b>
I	Solid State	4
II	Solutions	5
III	Electrochemistry	5
IV	Chemical Kinetics	4
V	Surface Chemistry	4
VI	General Principles and Processes of Isolation of Elements	3
VII	p-Block Elements	3
VIII	d- and f- Block Elements	5
IX	Coordination Compounds	3
X	Haloalkanes and Haloarenes	4
XI	Alcohols, Phenols and Ethers	4
XII	Aldehydes, Ketones and Carboxylic Acids	6
XIII	Organic Compounds containing Nitrogen	4
XIV	Biomolecules	4
XV	Polymers	3
XVI	Chemistry in Everyday Life	3
		<b>70</b>

**Unit I: Solid state****(Periods 12)**

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea), Crystal Lattices and unit cells, calculation of density of unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties.

**Unit II: Solutions****(Periods 12)**

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties – relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass.

**Unit III: Electrochemistry****(Periods 14)**

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell – electrolytic cells and Galvanic cells, lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, fuel cells, corrosion.

**Unit IV: Chemical kinetics****(Periods 12)**

Rate of a reaction (average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half life (only for zero and first order reactions), collision theory (elementary idea, no mathematical treatment)

**Unit V: Surface chemistry****(Periods 8)**

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Adsorption – physisorption and chemisorption, factors affecting adsorption of gases on solids, catalysis : homogenous and heterogeneous, activity and selectivity, enzyme catalysis; colloids distinction between true solutions, colloids and suspensions; lyophilic, lyophobic, multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsion – types of emulsions.

**Unit VI: General principles and processes of isolation of elements**  
(Periods 8)

Principles and methods of extraction - concentration, oxidation, reduction-electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and iron.

**Unit VII: p-block elements** (Periods 14)

**Group 15 Elements**

General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; nitrogen - preparation, properties and uses; compounds of nitrogen: preparation and properties of ammonia and nitric acid, oxides of nitrogen (structure only); Phosphorous-allotropic forms, compounds of phosphorous: preparation and properties of phosphine, halides ( $\text{PCl}_3$ ,  $\text{PCl}_5$ ) and oxoacids (elementary idea only)

**Group 16 Elements**

General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; dioxygen: preparation, properties and uses, simple oxides, Ozone, Sulphur - allotropic forms; compounds of sulphur: preparation, properties and uses of sulphur dioxide, sulphuric acid: industrial process of manufacture, properties and uses, oxoacids of sulphur (structures only).

**Group 17 elements**

General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens (structures only).

**Group 18 elements**

General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

**Unit VIII: d and f block elements** (Period 14)

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of  $\text{K}_2\text{Cr}_2\text{O}_7$  and  $\text{KMnO}_4$ .

**Lanthanoids**

electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction.

**Actinoids**

Electronic configuration, oxidation states.

**Unit IX: Coordination compounds** (Period 12)

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. bonding,

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isomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems).

**Unit X: Haloalkanes and Haloarenes** (Periods 12)

**Haloalkanes**

Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions.

**Haloarenes**

Nature of C-X bond, substitution reactions (directive influence of halogen in monosubstituted compounds only)

Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

**Unit XI: Alcohols, Phenols and Ethers** (Periods 12)

**Alcohols**

Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses of methanol and ethanol.

**Phenols**

Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols.

**Ethers:** Nomenclature, methods of preparation, physical and chemical properties, uses.

**Unit XII: Aldehydes, Ketones and Carboxylic acids** (Periods 12)

**Aldehydes and Ketones**

Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses.

**Carboxylic Acids**

Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

**Unit XIII: Organic compounds containing nitrogen** (Periods 10)

**Amines**

Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

**Cyanides and Isocyanides**

will be mentioned at relevant places in context.

**Diazonium salts**

Preparation, chemical reactions and importance in synthetic organic chemistry.

**Unit XIV: Biomolecules** (Periods 12)

**Carbohydrates**

Classification (aldoses and ketoses), monosaccharides (glucose and fructose), oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen), importance.

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### **Proteins**

Elementary idea of  $\alpha$ - amino acids, peptide bond, polypeptides, proteins, structure of proteins- primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins, enzymes.

### **Vitamins**

Classification and functions.

### **Nucleic Acids**

DNA and RNA .

## **Unit XV: Polymers**

**(Periods 8)**

### **Classification**

natural and synthetic, methods of polymerization (addition and condensation), copolymerization, some important polymers: natural and synthetic like polythene, nylon, polyesters, bakelite, rubber.

## **Unit XVI: Chemistry in everyday life**

**(Period 8)**

### **Chemicals in medicines**

analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines.

### **Chemicals in food**

preservatives, artificial sweetening agents.

### **Cleansing agents**

soaps and detergents, cleansing action.

### **Practicals**

<b>Evaluation Scheme for Examination</b>	<b>Marks</b>
Volumetric Analysis	10
Salt Analysis	6
Content Based Experiment	4
Class record and viva	5
Investigatory Project	5
	<b>30</b>

## **Practicals Syllabus**

### **A. Surface chemistry**

**(Periods 6)**

- (a) Preparation of one lyophilic and one lyophobic sol. Lyophilic sol - starch, egg albumin and gum Lyophobic sol - aluminium hydroxide, ferric hydroxide, arsenous sulphide.
- (b) Study of the role of emulsifying agents in stabilizing the emulsions of different oils.

### **B. Chemical kinetics**

**(Periods 4)**

- (a) Effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.

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(b) Study of reaction rates of any one of the following:

- (i) Reaction of iodide ion with hydrogen peroxide at room temperature using different concentration of iodide ions.
- (ii) Reaction between potassium iodate,  $\text{KIO}_3$  and sodium sulphite: ( $\text{Na}_2\text{SO}_3$ ) using starch solution as indicator (clock reaction).

### **C. Thermochemistry**

**(Periods 4)**

Any one of the following experiments

- i. Enthalpy of dissolution of copper sulphate or potassium nitrate.
- ii. Enthalpy of neutralization of strong acid ( $\text{HCl}$ ) and strong base ( $\text{NaOH}$ )
- iii. Determination of enthalpy change during interaction (Hydrogen bond formation) between acetone and chloroform

### **D. Electrochemistry**

**(Period 2)**

Variation of cell potential in  $\text{Zn}/\text{Zn}^{2+}||\text{Cu}^{2+}/\text{Cu}$  with change in concentration of electrolytes ( $\text{CuSO}_4$  or  $\text{ZnSO}_4$ ) at room temperature.

### **E. Chromatography**

**(Periods 2)**

- i. Separation of pigments from extracts of leaves and flowers by paper chromatography and determination of  $R_f$  values.
- ii. Separation of constituents present in an inorganic mixture containing two cations only (constituents having large difference in  $R_f$  values to be provided).

### **F. Preparation of inorganic compounds**

**(Periods 4)**

- i. Preparation of double salt of ferrous ammonium sulphate or potash alum.
- ii. Preparation of potassium ferric oxalate.

### **G. Preparation of organic compounds**

**(Periods 4)**

Preparation of any two of the following compounds

- i. Acetanilide
- ii. Di-benzal acetone
- iii. p-Nitroacetanilide.
- iv. Aniline yellow or 2 - Naphthol aniline dye.
- v. Iodoform

### **H. Tests for the functional groups present in organic compounds**

**(Periods 6)**

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Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (primary) groups.

***I. Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given food stuffs. (Periods 4)***

***J. Determination of concentration/molarity of  $KMnO_4$  solution by titrating it against a standard solution of (Periods 8)***

- i. Oxalic acid,
- ii. Ferrous ammonium sulphate  
(Students will be required to prepare standard solutions by weighing themselves).

***K. Qualitative analysis (Periods 14)***

Determination of one cation and one anion in a given salt.

**Cations** -  $Pb^{2+}$ ,  $Cu^{2+}$ ,  $As^{3+}$ ,  $Al^{3+}$ ,  $Fe^{3+}$ ,  $Mn^{2+}$ ,  $Zn^{2+}$ ,  $Co^{2+}$ ,  $Ni^{2+}$ ,  $Ca^{2+}$ ,  $Sr^{2+}$ ,  $Ba^{2+}$ ,  $Mg^{2+}$ ,  $NH_4^+$

**Anions**

$CO_3^{2-}$ ,  $S^{2-}$ ,  $SO_3^{2-}$ ,  $SO_4^{2-}$ ,  $NO_2^-$ ,  $NO_3^-$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $PO_4^{3-}$ ;  $C_2O_4^{2-}$ ,  $CH_3COO^-$

**(Note: Insoluble salts excluded)**

## PROJECT

Scientific investigations involving laboratory testing and collecting information from other sources.

### A few suggested projects

- Study of presence of oxalate ions in guava fruit at different stages of ripening.
- Study of quantity of casein present in different samples of milk.
- Preparation of soybean milk and its comparison with the natural milk with respect to curd formation, effect of temperature, etc.
- Study of the effect of potassium bisulphate as food preservative under various conditions (temperature, concentration, time etc.)
- Study of digestion of starch by salivary amylase and, effect of pH and temperature on it.
- Comparative study of the rate of fermentation of following materials: wheat flour, gram flour, potato juice, carrot juice etc.
- Extraction of essential oils present in Saunf (aniseed), Ajwain (carum), Illaichi (cardamom).
- Study of common food adulterants in fat, oil, butter, sugar, turmeric powder, chilli powder and pepper.

**Note: Any investigatory project, which involves about 10 periods of work, can be chosen with the approval of the teacher.**

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***Recommended textbooks***

1. Chemistry Part - I, Published by NCERT
2. Chemistry Part - II, Published by NCERT