CHEMISTRY

SYLLABUS FOR HIGHER SECONDARY COURSE

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.

Objectives :

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 chemi·stry 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.

CHEMISTRY

SYLLABUS FOR HIGHER SECONDARY FIRST YEAR COURSE

One Paper (Theory) **Three Hours** **Marks 70**

Unitwise distribution of marks and periods :

Unit No.	Title	Marks	Periods
Unit-1	Some Basic concepts of chemistry	3	14
Unit-2	Structure of Atom	6	16
Unit-3	Classification of Elements and Periodicity in Properties	4	8
Unit-4	Chemical Bonding and molecular Structure	5	16
Unit-5	States of Matter: Gases and Liquids	4	14
Unit-6	Thermodynamics	6	16
Unit-7	Equilibrium	6	16
Unit-8	Redox Reactions	3	6
Unit-9	Hydrogen	3	8
Unit-10	S-Block Elements	5	14
Unit-11	Some P-Block Elements	7	16
Unit-12	Organic Chemistry : some basic Principles and Techniques	7	14
Unit-13	Hydrocarbons	8	16
Unit-15	Environmental Chemistry	3	6
		Total Marks : 70	180

Unitwise Distribution of Course contents :

Unit-1 : *Some Basic concepts of chemistry* **(Periods 14)**

General Introduction : Importance and scope of chemistry. Historical approach to particulate nature of matter, laws of chemical combination, Dalton's atomic theory, concept of elements, atoms and molecules. Atomic and molecular masses. Mole concept and molar mass; percentage composition and empirical and molecular formula; chemical reactions, stoichiometry and calculations based on stoichiometry

Unit-2 : *Structure of Atom* **(Periods 16)**

Discovery of electron, proton and neutron; atomic number, isotopes and isobars. Thompson's model and its limitations, Rutherford's model and its limitations, Bohr's Model and its limitations, concept of shells and subshells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p, and d orbitals, rules for filling electrons in orbitals-Aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of atoms, stability of half filled and completely filled orbitals.

Unit-3 : *Classification of Elements and Periodicity in Properties* **(Periods 8)**

Significance of classification, brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic trends in properties of elements -Periodic Trend and chemical reactivity atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy, electronegativity, valency.

Unit-4 : *Chemical Bonding and molecular Structure* **(Periods 16)**

Valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization involving s, p and d orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules (qualitative idea only), hydrogen bond.

Unit-5 : *States of Matter: Gases and Liquids* **(Periods 14)**

Three states of matter, intermolecular interactions, type of bonding, melting and boiling points, role of gas laws in elucidating the concept of the molecule, Boyle's law, Charles' law', Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro's number, ideal gas equation, deviation from ideal behaviour, liquefaction of gases, critical temperature.

Liquid State– Vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations).

Unit-6 : *Thermodynamics* **(Periods 16)**

Concepts of system, types of systems, surroundings, work, heat, energy, extensive and intensive propoerties, state functions.

First law of thermodynamics– internal energy and enthalpy, heat capacity and specific heat, measurement of ΔU and ΔH, Hess's law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomization, sublimation, phase transition, ionization and dilution.

Introduction of entropy as a state function, free energy change for spontaneous and non-spontaneous process, equilibrium.

Unit-7: *Equilibrium* **(Periods 16)**

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium– Le Chatelier's principle, ionic equilibrium– ionization of acids and bases, strong and weak electrolytes, degree of ionization, concept of pH. Hydrolysis of salts (elementary idea), buffer solutions, solubility product, common ion effect (with illustrative examples).

Unit-8 : *Redox Reactions* **(Periods 6)**

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reaction, applications of redox reactions.

Unit-9 : *Hydrogen* **(Periods 8)**

Position of hydrogen in periodic table, occurence, isotopes, preparation, properties and uses of hydrogen; hydrides– ionic, covalent and interstitial; physical and chemical propoerties of water, heavy water, hydrogen peroxide– preparation, reaction and structure; hydrogen as a fuel.

Unit-10 : *s-Block Elements* **(Periods 14)**

Group 1 and Group 2 elements :

General introduction, electronic configuration, occurence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens; uses.

Preparation and properties of some important compounds :

Sodium carbonate, sodium chloride, sodium hydroxide and sodium hydrogen carbonate, biological importance of sodium and potassium.

CaO, $CaCO_3$ and industrial use of lime and limestone, biological importance of Mg and Ca.

Unit-11 : *Some p-Block Elements* **(Periods 16)**

General Introduction to p-Block Elements :

Group 13 elements : General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group; Boron– physical and chemical properties, some important compounds : borax, boric acids, boron hydrides. Aluminium : uses, reactions with acids and alkalies.

Group 14 elements : General introduction, electronic configuratjon, occurrence, variation of properties, oxidation states, trends in chemical reactivity', anomalous behaviour of first element. Carbon– catenation, allotropic forms, physical and chemical properties; uses of some important compounds : oxides.

Important compounds of silicon and few uses : silicon tetrachloride, silicones, silicates and zeolites.

Unit-12 : *Organic Chemistry : some basic Principles and Techniques* **(Periods 14)**

General introduction, methods of purification, qualitative and quantitative analysis, classification and IUPAC nomenclature of organic compounds.

Electronic displacements in a covalent bond : inductive effect, electromeric effect, resonance and hyper conjugation.

Homolytic nnd heterolytic fission of a covalent bond : free radicals, carbocations, carbanions; electrophiles and nucleophiles, types of organic reactions.

Unit-13 : *Hydrocarbons* **(Periods 16)**

Classification of hydrocarbons :

Alkanes : Nomenclature, isomerism, conformations (ethane only), physical properties, chemical reactions including free radical mechanism of halogenation, combustion and pyrolysis.

Alkenes : Nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties, methods of preparation; chemical reactions : addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

Alkynes : Nomenclature, structure of triple bond (ethyne), physical properties, methods of preparation, chemical reactions : acidic character of alkynes, addition reaction of – hydrogen, halogens, hydrogen halides and water.

Aromatic hydrocarbons : Introduction, IUPAC nomenclature; Benzene : resonance, aromaticity; chemical properties: mechanism of electrophilic substitution– nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation; directive influence of functional group in mono-substituted benzene; carcinogenicity and toxicity.

Unit-14 : *Environmental Chemistry* **(Periods 6)**

Environmental pollution : Air, water and soil pollution, chemical reactions in atmosphere, smogs, major atmospheric pollutants; acid rain, ozone and its reactions, effects of depletion of ozone layer, greenhouse effect and global warming– pollution due to industrial wastes; green chemistry as an alternative tool for reducing pollution, strategy for control of environmental pollution.

SYLLABUS FOR CHEMISTRY PRACTICAL

Total Marks-30 **Total Periods-60**

Micro-chemical methods are available for several of the practical experiments. Wherever possible such techniques should be used.

A. Basic Laboratory Techniques **(Periods 4)**

1. Cutting glass tube and glass rod
2. Bending a glass tube
3. Drawing out a glass jet
4. Boring a cork

B. Characterisation and Purification of Chemical Substance **(Periods 8)**

1. Determination of melting point of organic compound
2. Determination of boiling point of organic compound.
3. Crystallization involving impure sample of any one of the following:
   Alum, Copper sulphate, Benzoic acid.

C. Experiments Related to pH Change **(Periods 8)**

(a) Any one of the following experiments:

- Determination of pH of some solutions obtained from fruit juices, solutions of known and varied concentrations of acids, bases and salts using pH or universal indicator.
- Comparing the pH of solutions of strong and weak acid of some concentration.
- Study the pH change in the titration of a strong acid with a strong base using universal indicator.

(b) Study of pH change by common-ion effect in case of weak acids and weak bases.

D. Chemical Equilibrium **(Periods 8)**

One of the following experiments:

(a) study the shift in equilibrium between ferric ions and thiocynate ions by increasing/ decreasing the concentration of either ions.

(b) Study the shift in equilibrium between $[Co(H_2O)_6]^{2+}$ and chloride ions by changing the concentration of either of the ions.

E. Quantitative Estimation **(Periods 16)**

- Using a chemical balance.
- Preparation of standard solution of oxalic acid.
- Determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid.
- Preparation of standard solution of sodium carbonate.
- Determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution.

E. Qualitative Analysis **(Periods 16)**

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

Cations-Pb^{2+}, Cu^{2+}, As^{3+}, Al^{3+}, Fe^{3+}, Mn^{2+}, Ni^{2+}, Zn^{2+}, Co^{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)

G. *Project* ***(Periods 10)***

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

A few suggestion projects

- Checking the bacterial contamination in drinking water by testing sulphide ions.
- Study of the methods of purification of water.
- Testing the hardness, presence of iron, fluoride, chloride etc. depending upon the regional variation in drinking water and the study of causes of presences of these ions above permissible limit (if any)
- Investigation of the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on them.
- Study of the acidity of different samples of the tea leaves.
- Determination of the rate of evaporation of different liquids.
- Study of the effect of acids and bases on the tensile strength of fibers.
- Analysis of fruit and vegetable juices for their acidity.

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