

Chemistry

Code No. 313

Introduction

Chemistry is a branch of Physical Sciences that studies the composition, structure, properties and change of matter. Chemistry is sometimes called the Central Science because it bridges other Natural Sciences including Physics, Geology and Biology. Chemistry plays a pivotal role in many areas of science and technology viz. health, medicine, energy and environment, food, agriculture and new materials.

Rationale

According to present scheme of school education at Senior Secondary stage, chemistry emerges as a separate discipline. It is this stage where major emphasis is laid on providing suitable conceptual foundation. The present Senior Secondary level Chemistry (313) course at NIOS has now been revised as per the Common Core Curriculum developed by COBSE (Council of Boards of School Education) and NCERT (National Council for Educational Research and Training) making it current and need based.

The present Chemistry course has been developed basically around the themes: Why do chemical reactions occur? What is the quantitative relationship among reacting constituents in a chemical reaction? How far and how fast will a chemical reaction proceed under a given set of conditions? Can we predict whether a chemical reaction will occur or not? What is the relation between the structure of a chemical substance and its functions/properties? In what way is a chemical reaction relevant for getting new types of substances and materials for daily life and chemical industries?

Objectives

After completing this course, the learner will be able to:

- explain the principles, theories and laws of chemistry responsible for various chemical processes/ reactions;
- realise the role of chemistry in production of many elements (metals/non-metals) and compounds useful in industries and daily life;
- identify the chemical nature of inorganic and organic substances around him/her;
- choose various vocational, professional and applied courses of choice based on knowledge of chemistry gained;
- perform chemical calculations to know about the chemical reactions and chemical compounds;
- explain chemical reactions, concepts and phenomenon;
- develop awareness about uses and abuses of chemical substances;
- develop skills of arranging/setting apparatus, handling apparatus and chemicals properly ; and
- analyse and synthesise simple compounds.

Scope and job opportunity

This field has a large number of opportunities for employment, some of these are:

Chemical Sciences (Chemistry) offer access to a wide range of careers. The career options in chemistry are practically endless. Some of the important career opportunities after studying Chemistry at Senior Secondary level are petrochemical and pharmaceutical industries, analytical chemist, clinical biochemist, chemical development engineer, toxicologist, laboratory assistant, research associate/ research assistant, textile industry, biotechnology, biochemistry, plastic and polymer industry, quality controller, teacher, lecturer, professor, scientist, scientific journalist, forensic scientist and so on.

Eligibility conditions

Age: 15 years

Qualification: 10th pass

Medium of instruction: Hindi, English, Urdu, Bengali, Gujarati and Odia

Duration of the course: 1 Year

Weightage

Theory: 80 Marks

Practical: 20 marks

Tutor Marked assignments (TMA): 20% Marks of theory

Scheme of studies: Theory (240 hours), practical (30 hours), TMA (self- paced)

Scheme of evaluation

Mode of evaluation	Syllabus/Contents	Duration	Weightage
Tutor Marked Assignment (TMA)	All contents marked as TMA	Self paced	20%
Public/Final Examination	All contents marked as PE Practical	3 Hours(Theory) 3 Hours (Practical)	80%

Pass criteria: 33% in each component

Course content

S. No.	Module/Topics	Duration (in hours)	Description of Modules	Description of practicals	Weightage (marks)
1.	Module- I Some Basic Concepts of Chemistry 1. Atoms, Molecules and Chemical Arithmetics	13	This module deals with the scope of chemistry alongwith atomic theory of matter, laws of chemical combination, relationship between mass and number of particles. It also deals with stoichiometry. This module also deals with chemical formulas and chemical equations also.	Objectives of the present course in practical work are as follows: 1. To develop and inculcate laboratory skills and techniques. 2. To enable the student to understand the basic chemical concepts. 3. To develop basic competence of analysing and synthesising chemical compounds and mixtures. To meet these objectives three different types of laboratory experiments are provided in the present practical course. 1. Experiment for developing laboratory skills/ techniques 2. Concept based experiments 3. Traditional experiments (for analysing and synthesising chemicals) A. Introduction B. General Safety Measures	04

				<p>C. List of Experiments</p> <p>1. Basic Laboratory Techniques</p> <p>(i) Acquaintance with chemistry laboratory and basic laboratory techniques (cutting, bending and boring of glass tubes, sealing of apparatus, filtration, distillation, crystallisation, preparation calibration, cleaning of glass apparatus and use of burner etc.)</p> <p>(ii) Measurement of volume, length, mass and density.</p> <p>2. Characterization of Chemical substances</p> <p>(i) Determination of melting point of a solid organic compound of low melting point (below 100°C) by glass capillary tube method (Paraffin oil may be used as bath).</p> <p>3. Volumetric Analysis (Quantitative analysis)</p> <p>(a) preparation of solution of oxalic acid and ferrous ammonium sulphate</p>	
--	--	--	--	---	--

				<p>of known molarity by weighing (non-evaluative). Use of chemical balance to be demonstrated.</p> <p>(b) A study of acid-base titration (single titration only)</p> <p>(i) To find out the Molarity of given NaOH solution by titrating against standard solution of oxalic acid. Both the solutions to be provided</p> <p>(c) A study of redox titrations (single titration only)</p> <p>(i) To find out the Molarity and strength of given potassium permanganate solution by titrating against M/50 Mohr's salt (Ferrous ammonium sulphate) solution. Both the solutions to be provided.</p> <p>(d) To find out the Molarity and strength of given potassium permanganate solution by titrating against M/10 oxalic acid solution. Both the solutions to be provided.</p>	
--	--	--	--	---	--

2.	<p>Module- II</p> <p>Atomic Structure and Chemical Bonding</p> <p>2. Atomic Structure</p> <p>3. Periodic Table and Periodicity in Properties</p> <p>4. Chemical Bonding</p>	<p>This module is designed in such a manner so as to bring out the historical approach to the development of the various models of the atoms starting from experimental evidences leading to Rutherford's nuclear model, idea of line spectrum of hydrogen atom, idea of Bohr model, wave particle duality and Heisenberg's uncertainty principles, quantum number etc. This module also gives an idea about periodic table and periodicity in properties. Knowing from structure of atoms combine to form molecules and why do these combinations work.</p>		10
----	---	--	--	----

3.	Module- III State of Matter 5. Gaseous and Liquid States 6. The Solid State 7. Solutions 8. Colloids	28	This module highlights the behavior of different states of matter with reference to the kinetic molecular theory of gases, Wander walls' equation, important properties of liquids such as vapour pressure, surface tension and viscosity and structure of solids with reference to two dimensional lattice and unit cells as well as packing efficiencies. It will also give an idea about components of a solution, Raoult's law and abnormal molecular mass, colloidal solution, colloids, coagulation, emulsion etc are also being dealt in this module.	4. Preparation of dilute solutions Preparation of dilute solutions of known concentration of sulphuric acid, hydrochloric acid and nitric acid from their stock solution	08
4.	Module- IV Chemical Energies 9. Chemical	23	This module brings out the changes in energy and	5. Thermochemistry Any one of the following experiments	06

	<p>Thermodynamics</p> <p>10. Spontaneity of Chemical Reactions</p>		<p>occurring during dissolution processes and chemical reactions in terms of enthalpy along with first law of thermodynamics and Hess's law. This module also deals with spontaneity of chemical reactions to familiarize the concept that a chemical reaction involves energy changes. This module also brings out information about second and third laws of thermodynamics.</p>	<p>(ii) To determine the enthalpy of dissolution of copper sulphate or potassium nitrate To determine the enthalpy of neutralization of strong acid (HCl) with strong base (NaOH)</p>	
5.	<p>Module- V</p> <p>Chemical Dynamics</p> <p>11. Chemical Equilibrium</p> <p>12. Ionic Equilibrium</p> <p>13. Electrochemistry</p> <p>14. Chemical kinetics</p> <p>15. Adsorption and Catalysis</p>	36	<p>This module highlights the dynamic nature of chemical reactions which involves mixing substances together to get final products. It emphasizes equilibrium in solutions to explain acid or base behaviour. Also concept of</p>	<p>1. Experiment related to pH change</p> <p>(a) Determination of pH of following substances by using a universal indicator solution or pH papers.</p> <p>(i) Salt solution (ii) Acids and bases of different dilutions (iii) Vegetable and fruit juices</p> <p>(b) Study of pH change</p>	12

			<p>oxidation and reduction treated with the electrochemical cells to enable the learner to understand the concept of conversion of chemical energy to electrical energy. This module also brings out the information related to chemical kinetics, adsorption and catalysis.</p>	<p>by common-ion effect in case of weak acids and weak bases by above method (specific examples of CH_3COOH and CH_3COONa; and NH_4OH and NH_4Cl may be taken).</p> <ol style="list-style-type: none"> 2. Surface Chemistry <ul style="list-style-type: none"> • Preparation of lyophilic and lyophobic sol. Lyophilic sol - starch Lyophobic sol - aluminium hydroxide, ferric hydroxide. 3. Electrochemistry Variation of cell potential in $\text{Zn}/\text{Zn}^{2+} \text{Cu}^{2+}/\text{Cu}$ with change in concentration of electrolytes (CuSO_4 or ZnSO_4) at room temperature. 4. Chemical Equilibrium Study of the shift in equilibrium of the reaction between ferric ions and thiocyanate ions by increasing/ decreasing the concentration of these ions. 5. Chemical Kinetics <ul style="list-style-type: none"> • Study of the effect of concentration on the rate of reaction 	
--	--	--	--	---	--

				<p>between sodium thiosulphate and hydrochloric acid.</p> <ul style="list-style-type: none"> • Study of the effect of temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid. 	
6.	<p>Module- VI Chemistry of Elements</p> <p>16. Occurrence and Extraction of metals</p> <p>17. Hydrogen and s-Block elements</p> <p>18. General Characteristics of the p-Block Elements</p> <p>19. p-Block elements and their Compounds –I</p> <p>20. p-Block elements and their Compounds –II</p> <p>21. d-Block and f-Block Elements</p> <p>22. Coordination compounds</p>	60	<p>In this module, the periodic table is used as the basis for a study of chemistry of some of the common elements and its compounds. There are a large number of elements are found in nature i.e. the reason, the periodic trends to be followed to classify the elements. This module also deals with the characteristics of s-, p-, d- and f-block elements. You will also learn about the properties of transition elements and coordination compounds.</p>	<p>6. Preparation of Inorganic Compounds</p> <p>(i) Preparation of double salt of ferrous ammonium sulphate or potash alum.</p> <p>(ii) Preparation of potassium ferric oxalate.</p> <p>7. Qualitative Analysis</p> <p>Elementary qualitative analysis of a salt involving detection of one cationic and one anionic species from the following groups. (Salts insoluble in hydrochloric acid excluded).</p> <p>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^+</p> <p>Anions: CO_3^{2-}, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_2^-, NO_3^-, $C1^-$, Br^-, I^-, PO_4^{3-}, $C_2O_4^{2-}$, CH_3COO^-</p>	18

7.	<p>Module- VII Chemistry of Organic Compounds</p> <p>23. Nomenclature and General Principles</p> <p>24. Hydrocarbons</p> <p>25. Compounds of carbon containing Halogens (Haloalkanes and Haloarenes)</p> <p>26. Alcohol, Phenols and ethers</p> <p>27. Aldehydes, Ketones and Carboxylic Acids</p> <p>28. Compounds of Carbon containing Nitrogen</p> <p>29. Biomolecules</p>	60	<p>This module deals with the nomenclature, preparation and properties of hydrocarbons and their derivatives containing halogens, oxygen and nitrogen with different functional groups. The properties and uses of carbohydrates, proteins, fats and enzymes are also discussed in this module.</p>	<p>8. Preparation of Organic Compounds Preparation of any one of the following compounds:</p> <ul style="list-style-type: none"> • Acetanilide • Iodoform. <p>9. Chromatography (a) Separation of coloured substances by paper chromatography, and comparison of their R_f values for a mixture of red and blue ink or a black ink.</p> <p style="text-align: center;">OR</p> <p>(b) Separation of coloured substances by paper chromatography, and comparison of their R_f values for juice of a flower or grass.</p> <p>10. Detection of Elements Detection of nitrogen, sulphur, chlorine, bromine and iodine in an organic compound (combinations of halogens to be avoided). Not more than two of the above elements should be present in the given organic compound.</p>	18
----	---	----	---	--	----

				<p>11. Characteristic Tests for carbohydrates; fats and proteins and their detection</p> <p>Study of simple reactions of carbohydrates; fats and proteins. in pure form and detection of their presence in given food stuffs.</p> <p>12. Tests for the functional groups present in organic compounds</p> <p>Test of functional groups present in given unknown organic compounds</p> <p>(i) Test of unsaturation</p> <p>(ii) Test for Carboxylic, phenolic, aldehydic and ketonic groups.</p>	
8.	<p>Module- VIII</p> <p>Chemistry in Everyday Life</p> <p>30. Drug and Medicines</p> <p>31. Soaps, Detergents and Polymers</p> <p>32. Environmental Chemistry</p>	20	<p>This module deals with the chemistry in everyday life. This module highlights the role of chemistry in the field of drugs, medicines, soaps, detergents, and polymers. This module also deals with</p>		04

			environmental issues in the form of various types of pollution, global warming, ozone layer depletion etc. It also gives knowledge about achievement of green chemistry for reducing pollution.		
--	--	--	---	--	--