Chemistry
Grade: XI

Full Marks: 100(75 T+25P)
Pass Marks: 27T+10P
Teaching Hours: 150T+50P

I. Introduction

Chemistry is concerned with the physical and chemical characteristics of substances, the nature of matter and the study of chemical reactions. Chemistry, thus, is a powerful process of uncovering and extending our understanding of various chemical phenomena. The power resides in the combination of concepts and experiments involving careful observation and quantitative measurements under controlled conditions. The resulting concepts suggest further experiments and investigations as a result; there will be a modification of the existing concept leading to a creativity of thought. This creativity involves the recognition of a problem; formulation of ideas to solve the problem and ultimately refinement of the original ideas. The present curriculum aims to foster this uniqueness among students by enabling them to study both theoretical and practical aspects of chemistry.

This course is theory-cum-practical. It is intended to consolidate learning in chemistry achieved in the secondary school. Furthermore, it intends to provide a concrete knowledge and appropriate skills for those students, continuing further studies in chemistry and the students not studying the subject beyond this stage. The course seeks to maintain a balance between useful facts, concepts and theories which will facilitate understanding of the properties of substances, reactions and processes. Emphasis is enforced to stimulate, create and sustain students' interest in chemistry.

Chemistry being an experimental science, laboratory is an essential component of its syllabus. The course intends to make students aware of the importance of scientific method for accurate experimental work and develop the abilities to interpret, organize and evaluate data in order to make decisions and solve problems.

II. General Objectives

The general objectives of this course are to:

1. apply appropriate chemical principles, concepts, theories, definitions, laws, models and patterns to interpret, draw conclusion, make generalization, and predictions from chemical

facts, observations and experimental data;

2. select appropriate facts to illustrate a given principle, concept, theory, model and pattern;
3. present chemical ideas in a clear and logical form; and
4. select and organize data and perform calculations in which guidance on the method is not supplied.

III. Specific Objectives`

After studying the course, the student shall be able to:

1. state and apply fundamental facts and principles of chemistry dealing with the
    I. Methods of preparation: general, laboratory and industrial process of the matters,
    II. Physical and chemical properties,
    III. Important applications.
2. perform chemical calculations;
3. identify the mineral resources of Nepal;
4. understand chemical patterns and principles;
5. apply knowledge and understanding of chemistry in familiar and unfamiliar situations;
6. make accurate observations and measurements, being aware of possible sources of error;
7. record the results of experiments accurately and clearly; draw conclusion and make generalization from experiment ; and
8. appreciate the scientific, social , economic, environmental and technological contributions and applications of chemistry.

General & Physical Chemistry (Section A)

Unit 1: Language of Chemistry (Review Lecturers) - 3 teaching hours

1 Chemical equations, their significances and limitations
2 Balancing chemical equations by :
i. hit and trail method ii. Partial equation method
3 Types of chemical reaction

Unit 2: Chemical Arithmetic - 17 teaching hours

2.1 Dalton's atomic theory and Laws of Stoichiometry:

1 Postulates of Dalton's atomic theory
2 Law of conservation of mass

3 Law of constant proportions
4 Law of multiple proportions
5 Law of reciprocal proportions
6 Law of gaseous volumes
7 Chemical calculations based on stoichiometry

2.2. Atomic Mass and Molecular Mass:

Definition of atomic mass and molecular man
1 Mole concept
2 Mole in term of mass, volume number and ions
3 Calculation based on mole concept

2.3. Empirical, Molecular Formula and Limiting Reactants:

1 Percentage compositions
2 Derivation of empirical and molecular formula from percentage composition
3 Chemical calculation based on following chemical equation
- Limiting reactants
- Mass-mass relationship
- Volume – volume relationship
- Mass volume relationship

(Solving reacted numerical problems))

2.4. Avogadro's Hypothesis and Its Applications:

1 Development of Avogardro's hypothesis
2 Definition of Avogadro's hypothesis
3 Application of Avogadro's hypothesis
i. Deduction of atomicity of elementary gas
ii. Deduction of relationship between molecular mass and vapour density
iii. Deduction of molar volume of gases
iv. Deduction of molecular formula from its volumetric composition
(Solving related numerical problems)

2.5. Equivalent Masse:

1 Concept of equivalent mass
2 Equivalent weight of elements, and compounds (Salt, acid , base, oxidising agents, reducing agents)
3 Gram equivalent weight (GEW)
4 Relation between equivalent weight, valency and atomic weight
5 Determination of equivalent weight of metal by
i. Hydrogen displacement method ii. Oxide formation method
(Solving related numerical problems)

Unit 3: State of Matter **- 14 teaching hours**

3.1. Gaseous State:

1. Boyle's law
2. Charle's law and Kelvin scale of temperature
3. application of Charle's law and Boyle's law
4. Combined gas law, ideal gas equation and universal gas constant
5. Dalton's law of partial pressure
6. Mathematical derivation of Dalton's law and their applications
7. Graham's law of diffusion and its applications
8. Kinetic model of gas and its postulates
9. Ideal and real gases
10. Deviation of gas from ideal behaviour
    (Solving related numerical problems)

3.2 Liquid State:

1. Physical properties of liquid
    i. Evaporation and condensation
    ii. Vapour pressure of liquid and boiling
    iii. Surface tension
    iv. Viscosity
2. Solution and solubility:
    i. Equilibrium in saturated solution
    ii. Solubility and solubility curve and its applications.
    (Solving related numerical problems)

3.3. Solid Statem:

1. Crystalline and amorphous solids
2. Water of crystallization
3. Effloresences
4. Deliquesces
5. Hygroscopic
6. Seven types of crystal system
7. Simple cubic, face centered and body centered

Unit 4: Atomic Structure **- 10 teaching hours**

1. Discovery of fundamental particles of atom (electron, proton and neutron)
2. Concept of atomic number, mass number, fractional atomic mass, isotopes, isobars
3. Rutherford's α ray scattering experiment and nuclear model of atom; limitation
4. Bohr's model of atom and explanation of hydrogen spectra
5. Limitation of Bohr's model of atom
6. Elementary idea of quantum mechanical model

i. Dual nature of electron (de-Broglie equation)
ii. Heisenberg's uncertainty principle
iii. Probability concept

7 Shape of atomic orbital (s and p orbitals only)
8 Quantum numbers
9 Pauli's exclustion principle
10 Hund's rule of maximum multiplicity
11 Aufbau principle and Bohr Bury rule
12 Electronic configuration of the atoms and ions(Z = 1 to 30)

Unit 5: Nuclear Chemistry - 3 Teaching hours

1 Concept radioactivity
2 Radioactive rays (alpha ray, beta ray & gamma ray)
3 Meaning of natural and artificial radioactivity
4 Nuclear reactions, Nuclear energy (fission and fusion)
5 Nuclear isotopes and uses

Unit 6: Electronic Theory of Valency and Bonding - 8 teaching hours

1 Basic assumption of electronic theory of valency
2 Octet rule
3 Ionic bonds, ionic compounds and characteristics of ionic compounds. Lewis symbol to represent the formation of ionic compounds
4 Covalent bonds, covalent compounds and characteristics of covalent compounds – Lewis structure of some typical covalent compounds
5 Co-ordinate covalent bonds. Lewis structures of some typical co-ordinate covalent compounds
6 Exception of the octet rule
7 Partial ionic characters of covalent compounds. Non-polar and polar covalent molecules
8 Dipole moments and its application
9 Some special types of bonds: hydrogen bond and its types, metallic bond, vander Waal's bond, Resonance and resonance hybrid structures of O_3, SO_3, SO_2, CO_3^{-2}, SO_4^{-2}, PO_4^{-2}, NO_3^-
10 Classification of crystalline solids
i. Ionic solid
ii. Covalent solid
iii. Molecular solid
iv. Metallic solid

Unit 7: Periodic Classification of Elements - 6 teaching hours

1. Introduction
2. Mendeleev's periodic law and periodic table
3. Anamolies of Mendeleev's periodic table
4. Modern periodic law, and modern periodic table

5. Advantages of modern Periodic table
6. Division of elements into s,p, d and f blocks
7. Periodicity of physical properties: valency , atomic radii, ionic radii ionisation energy, electron affinity and electronegativity (general trends only)

Unit 8: Oxidation and Reduction - 6 teaching hours

1 Classical concept of oxidation and reduction
2 Electronic interpretation of oxidation and reduction
3 Oxidation number and rules for the assignment of oxidation number
4 Differentiate between oxidation number and valency
5 Oxidising and reducing agent
6 Redox reaction
7 Balancing redox reactions by
   i. oxidation number method
   ii. ion-electron method

Unit 9: Equilibria - 5 teaching hours

1. Introduction
2. Equilibrium involving in physical change
3. Chemical equilibrium
   - Reversible and irreversible reactions
   - Dynamic nature of chemical equilibrium and its characteristics
   - Law of mass action
   - Equilibrium constant (Kc) and its characteristics
   - Homogenous and heterogeneous equilibrium
   - Relation between Kp and Kc (derivation)
   - Le-chatelier's principle and its application

(No numerical is required)

Inorganic Chemistry

Section B

Unit 10: Non – Metals I - 12 teaching hours

10.1 Hydrogen:

1 Position in periodic table
2 Atomic hydrogen , Nascent hydrogen
3 Isotopes of hydrogen
4 Ortho and Para hydrogen
5 Applications

10.2. Oxygen:

1 Position in periodic table
2 Types of oxides
3 Uses of oxygen

10.3. Ozone:

1 Occurrence
2 Preparation from oxygen
3 Structure of ozone
4 Important properties of ozone
5 Ozone layer and ozone hole
6 Uses of ozone

10.4. Water:

1 Structure
2 Solvent property of water
3 Heavy water and uses
4 Uses

10.5 Nitrogen and Its Compounds:

1 Position of nitrogen in Periodic table
2 Uses of nitrogen
3 Types of nitrogen oxides (name and Lewis structure)
4 Ammonia
   - manufacture by Haber's synthesis method
   - Physical properties, chemical properties and uses
5 Oxyacids of nitrogen (type)
6 Technical production of nitric acid by Ostwald method
   - Properties of nitric acid and uses.
   - Test of nitrate ion

Unit 11: Non-Metals II - 23 teaching hours

11.1 Halogens: (Chlorine, Bromine and Iodine)

1 Position in periodic table
2 Comparative study on: preparation, properties and uses
3 Manufacture of bromine from carnallite process and manufacture of iodine form
   i. sea weeds (principle only) ii. caliche (Principle only)
4 Uses of halogens
5 Comparative study on ; preparation, properties and uses of haloacids (HCl, HBr and HI)

11.2. Carbon:

1 Position in periodic table
2 Allotropes of carbon including fullerenes
3 Laboratory preparation, properties and uses of carbon monoxides

11.3. Phosphorous:

1 Occurrence, position in periodic table
2 Allotropes of phosphorous and uses of phosphorus
3 Preparation, properties and uses of phosphine
4 Oxides and oxyacids of phosphorous (structure and uses)
5 Preparation, properties and uses of orthophospheric acid

11.4. Sulphur:

Position in periodic table and allotropes
1 *Hydrogen Sulphide:* (Laboratory methods and Kipp's apparatus), properties and uses of
2 *Sulphurdioxide :* Laboratory preparation, preparation and uses
3 *Sulphuric acid:* Manufacture by contact process, properties and uses
4 *Sodiumthiosulphate (hypo):* formula and uses
.

11.5. Boron and Silicon:

1 Occurrences, position in periodic table
2 Properties and uses
3 Formula and uses of burax, boric acid, Silicate and Silica

11.6. Noble gas: Position in periodic table, occurrence and uses

11.7. Environmental Pollution:
- Air pollution, photochemical smog
- Acid rain, water pollution
- Green house effect

Unit 12: Metal and Metallurgical Principles - 6 teaching hours

1 Characteristics of metals, non-metals and metalloids
2 Minerals and ores
3 Important minerals deposit in Nepal
4 Different process involved in metalurgical process
5 Concentration
6 Calcination and roasting
7 Smelting
8 Carbon reduction process

9 Thermite process
10 Electrochemical reduction
11 Refining of metals: poling, electro-refinement etc

Unit 13: Alkali and Alkaline Earth Metals - 10 teaching hours

1 Periodic discussion and general characteristics.
2 Sodium: Occurrence, Extraction from Downs process; properties and uses.
3 Sodium hydroxide: Manufacture, properties and uses.
4 Sodium carbonate: Manufacture, properties and uses.

13.1 Alkaline Earth Metals:

1 Periodic discussion and general characteristics
2 Preparation, properties and uses of i. quick lime, ii. plaster of Paris
iii. bleaching powder, iv. magnesia v. Epsom salt.

Organic Chemistry

Section C

Unit 14: Introduction to Organic Chemistry

14.1 Fundamental Principles: - 6 teaching hours

1 Definition of organic chemistry and organic compounds
2 Origin of organic compounds (vital force theory)
3 Reasons for the separate study of organic compounds
4 Tetra covalency and catenation property of carbon
5 Classification of organic compounds
6 Functional groups and homologous series
7 Meaning of empirical formula, molecular formula, structural formula and contracted formula
8 Qualitative analysis of organic compounds. (detection of N,S and halogens by Lassaegne's test)

14.2. Nomenclature of Organic Compounds: - 6 teaching hours

1 Common names
2 IUPAC system and IUPAC rules of naming hydrocarbons, alcohols, ethers, aldehydes, Ketones carboxylic acid, amines, ester, acid derivative halogen derivatives, nitriles etc.)

14.3. Structure Isomerism in Organic Compounds: - 2 teaching hours

1 Definition of structure isomerism

2 Types of structure isomerism: chain isomerism, position, isomerism, functional isomerism and metamerism

14.4 Preliminary Idea of Reaction Mechanism - 2 teaching hours

1 Concept of homolytic and herterolytic fission
2 Electrophile , nucleophiles and free- radicals
3 Inductive effect, +I and –I effect

Unit 15: Hydrocarbons

15.1 Sources: - 4 teaching hours

Origin of coal and petroleum , hydrocarbon from petroleum cracking and reforming , aliphatic and aromatic hydrocarbon form coal, quality of gasoline, octane member and gasoline additive.

15.2 Alkanes (Saturated Hydrocarbons):

1 General methods of preparations :
   - Decarboxylation
   - Catalytic hydrogenation
   - Reduction of haloalkane
   - Kolbe's electrolysis method
   - Using Grigrand's reagent
   - Wurtz reaction
   - From aldelydes and ketones
2 Physical properties
3 Chemical properties: Substitutions reaction, oxidation, pyrolysis or cracking aromatization

15.3. Alkenes : - 4 teaching hours

1 General methods of preparation
   - Dehydration of alcohol
   - Dehydrohalogenation
   - Catalytic hydrogenation of alkyne
   - Kolbe's electrolysis
2 Laboratory preparation of alkene
3 Chemical properties of alkene: Addition reaction (H_2,X_2,HX, H_2O, O_3, H_2SO_4)
4 Oxidation with alkaline $KMnO_4$ (Baeyer's reaction)
5 Polymerisation
6 Test of ethene and uses

15.4. Alkynes :

- 3 teaching hours

Ethyne

1 Preparation form i. carbon and hydrogen ii. Kolbes electrolysis iii. 1,2 dibromoethane

2 Lab preparation of ethyne
3 Physical properties
4 Chemical properties: Addition (H_2,X_2, HX, H_2O, O_3), Acidic nature (action with ammonical $AgNO_3$ and ammonical Cu_2Cl_2) , Oxidation with alkaline $KMnO_4$, Polymerization uses of ethyne

Practical

Full Marks: 25
Pass Marks: 10

Students are required to secure the pass marks in the practical paper separately. The following is the list of experiments. The students are required to perform in the practical classes in Grade XI.

A. Experiments based on laboratory techniques:

1. To separate the insoluble component in pure and dry state from the given mixture of soluble and insoluble solids. (NaCl and sand)
2. To separate volatile component form the given mixture of volatile and non volatile (demonstration of sublimation process)
3. To separate a mixture of two soluble solids by fractional crystallization (KNO_3 + NaCl)
4. To prepare a saturated solution of impure salt and obtain the pure crystal of the same salt by crystallization
5. To separate the component of a mixture of two insoluble solids (The being soluble in dil acids)
6. To obtain pure water from given sample of water (Distillation).

B. Experiment to study the different reactions (Neutralization, Precipitation, Redox reaction, electrolysis):

7. To perform precipitation reaction of BaCl2 and H_2SO_4 and obtain solid $BaSO_4$;
8. To neutralize sodium hydroxide with hydrochloric acid solution and recover the crystal of sodium chloride
9. To test the ferrous ions in the given aqueous solution and oxidise it to ferric ion
   (Ferrous $\rightarrow$ Ferric system)
   Redox Reaction
10. To study the process of electrolysis and electroplating.

C. Experiments on quantitative analysis:

11. To determine the equivalent weight or weight of metal by hydrogen displacement method;
12. To determine the solubility of the given soluble solid at laboratory temperature;
13. To determine the relative surface tension of unknown liquid by drop count method;and
14. To study the rate of flow of liquid through Ostwald's viscometer and determine the relative viscosity of unknown liquid.

D. Experiments on preparation of gas and study of properties:

15. To prepare and collect hydrogen gas and study the following properties;
    a. Solubility with water, colour, odour;
    b. Litmus test;
    c. Burning match stick test; and
    d. Reducing properties of nascent hydrogen.

16. To prepare and collect ammonia gas and investigate the following properties:
    a. Solubility with water / colour / odour;
    b. Litmus test;
    c. Action with copper sulphate solution; and
    d. Action with mercurous nitrate paper.

17. To prepare carbondioxide gas and investigate the following properties:
    a. Solubility,colour, odour;
    b. Litmus paper test;
    c. Lime water test; and
    d. Action with burning magnesium ribbon.

18. To study the properties of hydrogen sulphide (Physical, analytical and reducing);

19. To study the following properties of sulphuric acid:
    a. Solubility with water;
    b. Litmus paper test;
    c. Precipitating reaction;and
    d. Dehydrating reaction.

E. Experiments on qualitative analysis:

20. To detect the basic radical of the given salt by dry way and the acid radical by dry and wet ways.
    Basic radicals: Zn^{++}, Al^{+++}, NH_4^+, Ca^{++}, Na^+
    Acid radicals: CO_3^{--}, SO_4^{--}, NO_3^-, Br^-, I^-, Cl^-

Note: Experiment from no 1 to 19 requires one practical period of each experiment and the experiment no 20 requires four practical periods. (Two theory periods will be equivalent to one practical period)

Evaluation Scheme

The chemistry theory paper (XI) will consist of three types of questions:

(a) Very short-answer questions (weightage of 2 marks of each);
(b) Short-answer questions (weightage of 5 marks of each); and
(c) Long- answer questions (weightage of 10 marks of each).

According to manner of questions groups are divided into group 'A', group 'B' and group 'C'.

1 Group 'A' will consist of twenty two (22) very short questions, out of which, examinees are required to answer only fifteen (15) questions.
2 Group 'B' will consist of seven (7) short questions, out of which examinees are required to answer five (5) questions.
3 Group 'C' will consist of four (4) questions, out of which examinees are required to answer 2 questions.

The weightage of content distribution for the three types of questions form different sections of the curriculum will be as follows:

	Units	Teaching hours	V.S.Q.	S.Q.	L.Q.
	1	3	×		
	2	17	2		
	3	14	2		
	4	10	2		
	5	3	1		
	6	8	2		
	7	6	1		
	8	6	1		
	9	5	1		
	10	12	2		
	11	23	2		
	12	6	1		
	13	10	1		
	14	16	2		
	15	11	2		
Total	**15**	**150**	**22**	**7**	**4**

Prescribe textbook- To be written.

Reference books

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Grade: XII

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6. make accurate observations and measurements, being aware of possible sources of error;
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8. appreciate the scientific, social , economic, environmental and technological contributions and applications of chemistry.

General & Physical Chemistry (Section A)

Unit 1: Chemical Bonding and Shape of Molecules - 3 teaching hours

1 Hybridization and concept of sigma and pi bond

2 Valence shell Electron Pair Repulsion (VSEPR) theory

3 Prediction of molecular geometry (Shape of molecules) on the basis of VSEPR and hybridization. (BeF_2, BF_3, NH_3, H_2O, CH_4, H_2O, C_2H_2 C_2H_4 H_2S)

Unit 2: Volumetric Analysis - 8 teaching hours

1 Different ways of expressing the concentration of solutions

i. Molarity, ii. Normality iii. Molality iv. Gram /Litre v. Percentage

2 Titration : i. acid-base titration

ii. Redox titration

3 Primary standard substances, primary standard solution , secondary standard solution, end point, equivalence point, neutral point, indicators

4 Derivation of normality equation

5 Relation between normality and molarity

6 Selection of indicators in acid-base titration and P^H curve

7 Solving related numerical problems

Unit 3: Ionic Equilibrium - 12 teaching hours

1 Introduction

2 Ionization of weak electrolyte (Ostwald's dilution law)

3 Degree of ionization and ionization constant

4 Strength of acids and base interm of K_a, K_b and pK_a and pK_b values

5 Acid-base concept

i. Arrhenius concept of acids and bases.

ii. Bronsted lowrry concept of acids and bases

iii. Lewis concept of acids and bases.

6 Ionization of water, pH and pH scale.

7 Hydrolysis of salts. (qualitative concept)

8 Solubility product principle and its application

9 Common ion effects and its application

10 Application of solubility product principle in qualitative analysis

11 Buffer Solution

(Solving numerical problems related with solubility, solubility product, pH and pOH)

Unit 4: Electrochemistry - 10 teaching hours

1 Introduction

2 Electrolysis; strong and weak electrolyte

3 Arrehenius theory of ionization

4 Faraday's laws of electrolysis

5 Criteria of product formation during electrolysis
6 Electrolytic conduction, equivalent and molar conductivities
7 Variation of conductivity with concentration
8 Electrode potential, standard electrode potential,standard hydrogen electrode and its applications
9 Eletrochemical series and its use to predict the feasibility of redox reactions
10 Electrochemical cell (Galvanic cell)
11 EMF of electrochemical cell in the standard state

(Solving related numerical problems)

Unit 5: Energetics of Chemical Reactions - 8 teaching hours

1 Introduction , unit of energy
2 Some thermodynamical terms: system, surrounding , boundary , universe different types of system, state function, state variables and internal energy
3 Exchange of energy between the system and surrounding
4 Different types of thermodynamic process
5 The first law of thermodynamics
6 Sign convention of heat and work
7 Enthalpy, enthalpy change in chemical reactions
8 Hess's law of constant heat summation
9 Heat of neutralization, heat of solution, heat of combustion, heat of vapourization, heat of formation and bond energy

(Solving related numerical problems)

Unit 6: Chemical Thermodynamics - 6 teaching hours

1 Spontaneous process
2 Second law of thermodynamics
3 Entropy and its physical concept
4 Entropy change in phase transformation
5 Entropy and spontaneity
6 Entropy changes and their calculation
7 Gibb's free energy and prediction for the feasibility of reaction
8 Standard free energy change and equilibrium constant

9 Influence of temperature on spontaneous process
(Calculation involving in standard free energy change and equilibrium constant)

Unit 7: Chemical Kinetics - 10 Teaching hours

1 Concept of reaction rate
2 Average rate and instantaneous rate of a reaction
3 Factors that influences the rate of reaction
4 Rate law equation, rate constant and its units
5 I^{st} order, II^{nd} order, III^{rd} order and zero order reactions
6 Order and molecularity of a reaction
7 Integrated rate law for a first order reaction
8 Half-life of a reaction (first order)
9 Explaining the increase in reaction rate with temperature or collision theory (qualitative concept only)
10 Concept of activation energy as the energy barrier, activated complex and effect of catalyst on the rate of reaction
(Solving related numerical problems)

Organic Chemistry

Section B

Unit 8: Aromatic Hydrocarbon - 3 teaching hours

1 Definition, characteristics of aromatic compounds, Huckel's rule, structure of benzene, isomerism and orientation of benzene derivatives
2 Preparation of benzenes from
i. decarboxylation ii. phenol iii. ethyne iv. chlorobenzene
3 Physical properties of benzene
4 Chemical properties of benzene
i. Addition reaction : hydrogen, halogen and ozone

ii. Electrophilic substitution reactions: nitration, sulphonation, halogenation Friedal craft's alkylation and acylation
iii. Combustion of benzene and uses

Unit 9: Haloalkanes and Haloarenes - 8 teaching hours

9.1. Haloalkanes:

1 Introduction, classification and isomerism
2 Preparation of monohaloalkanes from alkanes, alkenes and alcohols
3 Physical properties of monohaloalkanes
4 Chemical properties
- Substitution reactions
- Elimination reaction (dehydrohalogenation)
- Grignard's reactions
- Reduction reactions
- Wurtz's reaction

5 Polyhaloalkane ;
- Laboratory preparation of trichloromethane from ethanol and proponone
- Physical properties of trichloromethane
- Chemical properties : oxidation reduction, action on Silver Powder, con. nitric acid, propanone, aqueous alkali, Carbylamine reaction , Remer Tiemann reaction , Iodiform reaction, etc.

9.2. Haloarenes:

- Preparation of chlorobenzene from i. benzene ii. benzene diazonium chloride
- Physical properties
- Chemical properties
  - Low reactivity of haloarene as compound to haloalkane in term of nucleophilic substitution reaction
  - Reduction of chlorobenzene
  - Electrophilic substitutre reactons
  - Action with Na, Mg and chloral etc.
  - Uses

Unit 10: Alcohols and Phenols - 10 teaching hours

10.1. Alcohols:

1 Introduction, classification, nomenclature and isomerism

2 Distinction of primary, secondary and tertiary alcohol by Victor Mayer's Method

3 Preparation of monohydric alcohols form i. haloalkane ii. Grignard's reagents using aldehydes and ketones iii. primary amines iv. Ester

4 Industrial preparation ethanol form: i. Oxoprocess ii. Fermentation of sugar iii. hydroboration of ethane

5 Physical properties monohydric alcohols

6 Chemical properties of monohydric alcohols

- Reaction with HX. PX_3, PCl_5 $SOCl_2$
- Action with reactive metals like Na, K, Li
- Esterification process
- Dehydration of alcohols.
- Oxidation of primary, secondary and tertiary alcohol with oxidizing agents.
- Reduction of alcohols (Catalyic dehydrogenation)
- Laboratory test of ethanol
- Absolute alcohol, methylated spirit, rectified spirit; alcoholic beverage.

- Preparation and uses of ethan- 1, 2. diol (glycol)
- Preparation and uses of Propan – 1, 2, 3 triol (glycerol)

10.2. Phenols:

1 Introduction to phenol

2 Preparation of phenol from i. chlorobenzene ii. Diazonium salt and iii. benzene sulphonic acid

3 Physical properties of phenol

4 Chemical properties

- Acidic nature of phenol
- Action with PCl_5, PX_3, NH_3, Zn, Na benzene diazonium chloride and phthalic anhydride
- Acylation reaction, Kolbe's reaction, Reimer Tiemann's reaction

- Electrophilic substitution: halogenation, nitration, sulphonation, brominaiton and Friedal Craft's alkylation
- Laboratory test of phenol
- Uses of phenol
-

Unit 11: Ethers - 4 teaching hours

11.1 Aliphatic Ethers:

1 Introduction, nomenclature classification, isomerism in ether

2 Preparation of ethers from i. alcohol ii. Williamson's etherification process

3 Laboratory preparation of ethoxy ethane form ethanol

4 Physical properties of ether

5 Chemical properties of etherxyethane

- action with HI , PCl_5, con. HCl, Conc. H_2SO_4 air and Cl_2
- Uses of ethoxy ethane

11.2 Aromatic Ether:

- Preparation of methoxy benzene (anisole)
- Halogenation, nitration and sulphonation reactions

Unit 12: Aldehydes and Ketones - 11 teaching hours

12.1 Aliphatic Aldehydes and Ketones

1 Introduction, structure of carbonyl group, nomenclature and isomerism in carbonyl compound

2 Preparation of aldehydes and ketones from

i. Dehydrogenation and oxidation of alcohol
ii. Ozonolysis of alkenes
iii. Acid chloride
iv. Gem dihaloalkane
v. Calalytic distillation of fatty acid
vi. Distillaiton of salt of fatty acid
vii. Calalyic hydration of alkynes

3 Physical properties

4 Chemical properties

i. Addition reaction: addition of H_2, HCN, $NaHSO_3$ and Grignand's reagents

ii. Action with ammonia derivatives; NH_2OH, NH_2-NH_2, phenyl hydrazine, semicarbazides and 2,4- DNP

iii. Reduction properties of aldelydes

- Oxidation with Tollen's reagent, Fehling's solution

iv. Aldol or condensation reaction; clemennson's reduction Wolf- Kischner reduction, Action with PCl_5, action with $LiAlH_4$

v. Special reaction of methenal; cannazzaro's reaction, action with ammonia, action with phenol. formalin and its uses

12.2 Aromatic Aldelydes and Ketones :

- Preparation of benzaldelyde from toluene
- Properties of benzaldelyde
- Important reaction benzaldelyde different form aliphatic aldelydes:
  - Perkin condensation
  - Benzoin condensation
  - Electrophilic substitution reaction
  - Cannizzaro's reaction
- Preparation of acetophenone by Friedal Craft's acylation

Unit 13: Carboxylic Acids - 10 teaching hours

13.1 Aliphatic Carboxylic Acids:

- Introduction, nomenclature, examples
- Preparation of monocarboxylic acids from

i. aldehydes ii. nitriles iii. Grignard's reagents iv. dicarboxylic acid v. sodium alkoxide. vi. trihaloalkanes

- Physical properties of monocarboxylic acids
- Chemical properties: Action with alkalies metal oxides, metal carbonates, metal

bicarbonates, PCl_3, $LiAlH_4$ and dehydration of carboxylic acid, esterification, halogenation

- Effect of constituents on the acidic strength of carboxylic acid
- Laboratory preparation of methanoic acid
- abnormal behaviour of methanoic acid
- Uses of carboxylic acid

13.2 Derivatives of Carboxylic Acid:

1 Nomenclature, preparation and properties of i. Acid halides ii. Acid amides iii. Acid anhydrides and iv. Esters

13.3 Aromatic Carboxylic Acids:

- Preparation of benzoic acid
- Physical and chemical properties
- Uses of benzoic acid

Unit 14: Nitrocompounds: - 4 teaching hours

14.1 Aliphalic Nitrocompounds (Nitroalkane):

2 Introduction and nomenclature
3 Preparation from haloalkane and alkane
4 Physical properties
5 Reduction of nitroalkane
6 Uses

14.2 Aromatic Nitrocompounds:

1 Laboratory preparation of nitrobenzene
2 Physical properties
3 Chemical properties
    - Reduction in different media
    - Electrophilic substitution reactions
    - Uses of nitrobenzene

Unit 15: Amino Compounds (Amines and Aniline) - 7 teaching hours

15.1 Aliphatic Amines:

1 Introduction, nomenclature and classification

2 Separation of primary , secondary and tertiary amines by Hoffmann's method

3 Preparation of primary amines form haloalkane , nitriles, nitroalkanes and amides

4 Physical properties

5 Chemical Properties: basicity of amines, comparative study of basic nature of 1^0, 2^0 and 3^0 amines. Reaction of Primary amines with chloroform, conc. HCl, R-X, RCOX and nitrous acid ($NaNO_2$ / HCl)

6 Test of 1^0, 2^0 and 3^0 amines. (nitrous acid test)

15.2 Aromatic Amine (Aniline):

1 Laboratory preparation of aniline

2 Physical properties

3 Chemical properties: bassicity of aniline, comparision of basic nature of aniline with aliphatic amines; alkylation , acylation , diazotization, carbylamine and coupling reaction

4 Electrophilic substitution : Nitration sulphonation and bromination

5 Uses of anitne

Unit 16: Molecules of Life - 8 teaching hours

1 Carbohydrates: definition, classification of carbohydrates, various examples of carbohydrate of different class. structure and glucose and fructose, function of carbohydrates , sugar and non-sugar

2 Protein :definition, amino acid , essential and non-essential aminoacids, peptide linkage, hydrolysis of aminoacids, denaturation of protein, zwitter ions, functions of aminoacids

3 Nucleic acid: definition, basic components of nucleic acid; doule helix, difference between RNA and DNA; biological function of nucleic acid

4 Lipid: definition, fatty acids, fat as ester of fatty acid and difference between fats and oils, function of lipid

5 Enzymes and their functions

Unit 17: Chemistry in Service to Mankind - 10 teaching hours

1 Polymer: definition, natural and synthetic polymers, homopolymers and co-polymer Preparation of some polymers; PVC polyethene polystyreno Teflon, Nylon-66, Bakelite and their uses
2 Dyes: definition, natural and synthetic dyes, names and structure of some common drug, drug addiction
3 Fertilizer: definition, chemical and organic fertilizers, nitrogen fertilizer, phosphatic fertilizer; fertilizer as pollution
4 Pesticides: insecticides, herbicides. weedicides and fungcides (examples and their uses)

Inorganic Chemistry

Section C

Unit 18: Heavy Metals -18 teaching hours

1 General Characteristics of Transition Metals

18.1. Copper:

1 Position in periodic table
2 Occurrence and extraction of copper form copper pyrites
3 Properties and uses
4 Chemistry of (i) blue vitriol (ii) black oxide of copper (iii) red oxide of copper

18.2 Zinc:

1 Position in periodic table
2 Occurrence and extraction of zinc from zinc blende
3 Properties and uses of copper
4 Preparation properties and uses of zinc white and white vitriol
5 Galvanization

18.3 Mercury:

1 Occurrence and extraction of Hg from Cinnabar
2 Properties of mercur
3 Mercury poisoning and uses of Hg
4 Preparation, properties and uses of (i) Calomel (ii) Corrosive Sublimate

18.4. Iron:

1. Occurrence and extraction
2. Varieties of Iron
3. Properties of Iron
4. Manufacture of Steel by
    i. Bessemer process
    ii. Open hearth process
5. Heat treatment of steel
6. Stainless steel
7. Rusting of iron and its prevention
8. Uses and biological importance of iron
9. Structure and uses of green vitriol, Ferric chloride Mohr's salt

18.5. Silver:

1. Extraction of Silver by cyanide process and its uses
2. Preparation and uses of
    iv. Silver chloride
    v. Silver nitrate

Practical

Full Marks: 25
Pass Marks: 10

Students are required to secure the pass marks in the practical paper separately from the theory paper. The following is the list of experiments. The students are required to perform in the practical classes in Grade XII.

A. Experiments based on recovery and preparation of salt.

1. To recover blue vitriol crystal from the given mixture of copper sulphate and Sodium chloride;
2. To recover $CaCO_3$ from the mixture of $CaCO_3$ and $MgCO_3$ (dolomite); and
3. To obtain hydrated calcium sulphate form the given marble chips.

B. Experiments on volumetric analysis (Titration)

4. To prepare primary standard solution of Na_2CO_3 and standardize the given acid solution HCl by the standard solution;
5. To determine the strength of approximate $\frac{N}{10}$ NaOH solution with the help of standard decimal solution of HCl supplied
6. To determine the strength of bench sulphuric acid (H_2SO_4) with the help of standard NaOH or Na_2CO_3 solution and express the concentration in (i) normality (ii) molarity (iii) gm/litre (iv) percentage (Double titration)
7. To standardize the given approximate $\frac{N}{10} KMnO_4$ solution with the help of primary standard oxalic solution. (Redox titration) ;
8. To determine the enthalpy of neutralization of a strong acid and strong base;
9. To complete salt analysis by dry and wet ways. (at least 3 salts);
10. To detect foreign elements present in a given organic compounds. (N, S and X);
11. To identify the functional group present in the organic compounds. (OH, -COOH, - CHO, > CO, - NH_2); and
12. To test the presence of

a. Saturated or unsaturated fats,
b. Carbohydrate,
c. Proteins,
d. Phenol.

Note: The experiment no.9 requires 4 practical periods. The experiment no. 10 requires 3 practical periods, the experiment no. 11 requires 3 periods and remaining experiments require 1 period of each. (2 theory periods will be equivalent to 1 practical period.)

Evaluation Scheme

The chemistry theory paper (XII) will consist of three types of questions:

(a) Very short-answer questions (weightage of 2 marks of each);
(b) Short-answer questions (weightage of 5 marks of each);
(c) Long- answer questions (weightage of 10 mark of each.)

According to nature of questions, groups are divided into group 'A', group 'B' and group 'C'.

1 Group 'A' will consist of twenty two (22) very short questions, out of which, examinees are required to answer only fifteen (15) questions.
2 Group 'B' will consist of seven (7) short questions, out of which examinees are required to answer five (5) questions.
3 Group 'C' will consist of four (4) questions, out of which examinee are required to answer 2 questions.

The weightage of content distribution for the three types of questions form different sections of the curriculum will be as follows:

	Units	**Teaching hours**	**V.S.Q.**	**S.Q.**	**L.Q.**
	1	3	1		
	2	8	1		

	3	12	1		
	4	10	1		
	5	8	1		
	6	6	1		
	7	10	1		
	8	3	1		
	9	8	1		
	10	10	1		
	11	4	1		
	12	11	1		
	13	10	1		
	14	4	1		
	15	7	1		
	16	8	2		
	17	10	2		
Inorganic Chemistry	18	18	3	1	0.5
Total	**18**	**150**	**22**	**7**	**4**

Prescribe textbook- To be written.

Reference books