REPUBLIQUE DU CAMEROUN
Paix – Travail – Patrie

REPUBLIC OF CAMEROON
Peace – Work - Fatherland

MINISTRY OF SECONDARY EDUCATION
MINISTERE DES ENSEIGNEMENTS SECONDAIRES

INSPECTORATE GENERAL OF EDUCATION
INSPECTION GENERALE DES ENSEIGNEMENTS

CHEMISTRY TEACHING SYLLABUS FOR THE SECOND CYCLE (LOWER AND UPPER SIXTH SCIENCES) OF SECONDARY GENERAL EDUCATION

January 2020

MINISTRY OF SECONDARY EDUCATION

REPUBLIC OF CAMEROON

Peace – Work – Fatherland

ORDER N°.....09/20.....MINESEC OF ..... 24 JAN 2020

Setting out the curricula for Première, Lower and Upper Sixth classes of Secondary General Education

THE MINISTER OF SECONDARY EDUCATION

Mindful of the Constitution;

Mindful of Law N° 98/004 of 14 April 1998 on Guidelines of Education in Cameroon;

Mindful of Decree N° 2012/267 of 11 June 2012 organising the Ministry of Secondary Education;

Mindful of Decree N° 2011 of 9 December 2011 organising the Government, amended and supplemented by Decree N° 2018/190 of 2 March 2018;

Mindful of Decree N° 2018/191 of 2 March reshuffling the Government, amended and supplemented by Decree N° 2019/002 of 4 January 2019,

HEREBY ORDERS AS FOLLOWS

Article 1 : The curricula for Première, Lower and Upper Sixth classes are defined as follows:

PREFACE

THE PROGRAMME OF STUDY FOR PREMIERE, LOWER AND UPPER SIXTH CLASSES OF SECONDARY GENERAL EDUCATION

The quantitative and qualitative improvement of education is a permanent concern for the Cameroonian State, which is keen on achieving its emergence by 2035. Thus, in accordance with the Sustainable Development Goals (SDGs), the Strategy Document for Growth and Employment (SDGE) and the Education and Training Sector Strategic Plan (ETSSP), the Ministry of Secondary Education has, for almost ten years now, committed itself to curriculum reform. This reform, which has resulted in the implementation of the new first cycle curricula following the Competence-Base Approach (CBA) with real life situations, has continued with the rewriting of curricula for second cycle classes of both subsystems. This reform is carried out in respect of number of requirements:

(i) Carry out teaching/learning following the Competence-Base Approach, in order to provide as many young Cameroonians as possible with quality training;

(ii) Actively participate in exposing secondary school students to global citizenship, new technologies, social inclusion and future possibilities in higher education.

The rewriting of the curricula for Première, Lower and Upper sixth classes of Secondary General Education has once again consolidated the achievements of Cameroon in its vision of education as defined in the Law of Orientation of Education and implemented through the Competence-Base Approach. It confirms the willingness to follow the guidelines of the two steering documents, the Strategy Document for Growth and Employment (SDGE) and the Education and Training Sector Strategic Plan (ETSSP).

It has to do with continuing to equip learners with the necessary resources (essential knowledge, know-how, life skills, speaking skills, etc.), the effective development of the skills expected at the end of secondary school, and necessary for further studies in higher education.

While reaffirming my congratulations to the entire team of curriculum designers, I call on the entire members of the educational community, teachers in particular who are the driving force of pedagogy, to have a mastery of the conceptual and operational foundations of the Competence- Based Approach (CBA), considering that this is the paradigm chosen for the implementation of the new curricula in Cameroon.

Nkiza Lyonga, Ph.D.

REPUBLIC OF CAMEROON
Peace-Work-Fatherland

MINISTRY OF SECONDARY EDUCATION

INSPECTORATE GENERAL OF EDUCATION

INSPECTORATE OF PEDAGOGY IN CHARGE OF THE TEACHING OF SCIENCES

REPUBLIQUE DU CAMEROUN
Paix-Travail-Patrie

MINISTERE DES ENSEIGNEMENTS SECONDAIRES

INSPECTION GENERALE DES ENSEIGNEMENTS

INSPECTION DE PEDAGOGIE CHARGEE DES ENSEIGNEMENTS DES SCIENCES

LEARNING AREA: SCIENCE AND TECHNOLOGY

SUBJECT: CHEMISTRY

CLASSES: LOWER SIXTH AND UPPER SIXTH SCIENCES

PLANNING OF TEACHING/LEARNING & EVALUATION

ANNUAL WORKLOAD: 324 PERIODS (270 HOURS)

WEEKLY WORKLOAD:
- **TEACHING: 06 PERIODS (05 HOURS)**
- **PRACTICALS: 03 PERIODS (2.5 HOURS)**

COEFFICIENT: 05

TABLE OF CONTENTS

INTRODUCTION

This Chemistry Teaching Syllabus is a statement of defined coursework to educate Cameroonians in the sixth and seventh years of Chemistry in the Second Cycle of Secondary General Education. It has been developed as an integrated course which aims to contribute towards a mixing of new and old material so that the new concepts permeate the whole; applying a new vision or approach to Teaching/Learning: **The Competency-Based Approach** (CBA).
This syllabus also aims at creating awareness in the student of the importance of chemistry in the society. It is conceived to provide a smooth transition from the daily realities of chemistry in the student's life to more concrete concepts without creating a barrier.

It caters for the student whose previous education in Chemistry is based on the aspects of chemistry studied in Forms 1 - 5 and prepares the student to the acquisition of the Advanced Level Certificate and/or vocational training. It therefore covers the requirements of the Cameroon General Certificate of Education Board (CGCEB) Examination Syllabus, and more.

The Goals

The general aims and objectives for the whole Chemistry course are broken down to specific goals/aims which are progressive. For the Lower Sixth Sciences (LSS) and Upper Sixth Sciences (USS) classes, they are to acquire knowledge, reinforce comprehension of principles, promote the application of these concepts and inculcate into students the skills of analysis/synthesis/evaluation in chemistry; and are as follows:

1. Specific behaviour of substances;
2. Patterns in Chemistry;
3. Experimental techniques and procedures including design of experiments;
4. Qualitative and Quantitative aspects including calculations;
5. Concepts and principles;
6. Chemistry and society;
7. Chemistry and environment;
8. Handling problems in everyday life by using ideas, concepts and skills developed in the Chemistry course;
9. Creating an awareness of Chemistry in the Cameroonian society and the world and an application of the social and environmental aspect of Chemistry.

The entire syllabus is written using the Competency-Based Approach with daily life situations as the focal point and also chemistry situations, using the student-centred experimental approach to the teaching/learning of the subject in each of the classes. The experimental resources to be used at all levels of the teaching syllabus include:

- Simple materials in the environment;
- Conventional laboratory chemicals and equipment;
- Microchemistry equipment.

Weekly allocation of Teaching/Learning Hours per subject

The number of **hours per week** for teaching/learning of each of the science subjects offered in the second cycle is as in the Table below. The number of teaching/learning periods per week will depend on the duration of each period (number of minutes) for the institution concerned.

N°	**Subject/Class**		**LSS_1**	**LSS_2**	**LSS_3**	**LSS_4**	**LSA_4**	**USS_1**	**USS_2**	**USS_3**	**USS_4**	**USA_4**
1	Mathematics with Mechanics /Statistics		8	8	8	8	8	8	8	8	8	8
2	Further Mathematics.		4	4				8	8			
3	Physics	Theory	6	6				6	6		6	
		Practical	2	2				2	2		2	
4	Chemistry	Theory	6	6	6	6		6	6	6	6	
		Practical	2	2	2	2		2	2	2	2	
5	Biology	Theory		6	6	6			6	6	6	
		Practical		2	2	2			2	2	2	
6	Geology	Theory				6					6	
		Practical				2					2	
7	Food Science and Nutrition	Theory			6	6				6	6	
		Practical			2	2				2	2	
8	Computer Science/ICT	Theory	4		4			6		6		
		Practical	2		2			2		2		

Weekly Time allocation for Chemistry

To cover this syllabus for theory, demonstrations and practicals, the recommended **weekly** time allocation (**in periods**) for the LSS and USS forms is as follows:

CLASS	**TIME ALLOCATION (A period is 50 minutes)**	**Weekly Periods**	**Sequence Periods**
LSS	Three double periods of Theory and one triple period of Practicals	09 Periods	54 Periods
USS	Three double periods of Theory and one triple period of Practicals	09 Periods	54 Periods

It is recommended, however, that whenever practical hours are not being used for practical exercises, this time should be used in teaching the theory part of the course, to ensure a good coverage of the syllabus and teaching hours/periods allocated by the end of the academic year. Teachers are, therefore,

expected to exploit their time tables in such a way as to use all the practical periods for hands-on-experience and/or practicals; and to choose and realise at least one simple specified school project or field trip to an industrial site, that should be realised by the end of USS.

Profile of Learner at the end of the Second Cycle

By the end of the second cycle this program of study is expected to inculcate (promote) in the learner responsible behaviour, knowledge and competencies. The learner should then be able to **express their scientific and social know-how** which should enable him/her to be able to:

- apply scientific reasoning to solve real life situations;
- explain natural phenomena;
- meet with the challenges of life, through the use of scientific approach in problem solving;
- manage the environment in a sustainable manner;
- safeguard his/her health and that of all others in his/her surrounding;
- imbibe the scientific method;
- use process skills to acquire knowledge;
- read and interpret security notices;
- communicate his/her results;
- relate the learning of Chemistry to everyday life.

Evaluation

The evaluation of this syllabus will aim at testing the knowledge and competencies (skills, abilities) in different areas:

- Ability to apply the understanding in solving problems, the ability to use the scientific information given, for example in graphical or tabular form.
- Ability to organise material and present ideas in a clear and logical manner.
- Ability to handle patterns in chemical knowledge and show critical, imaginative and inferential thinking skills.
- Practical skills will be evaluated with respect to:
  - quantitative and qualitative analyses;
  - design and use of experiments;
  - laboratory safety measures;
  - use of and care for equipment;
  - school project and/or field trip.

- By the end of the two years of studies in the second cycle, the learner will be required to have shown proof of the acquisition of a specified number of competencies. See Table on minimum expected competencies to guide you (page 12).

All forms of evaluation will place emphasis on the specified competencies/aptitudes outlined for each topic/module.

Subject Combinations and Career Profiles

Chemistry is the core subject of the sciences and hence appears in all science combinations in the second cycle of Secondary General Education in Cameroon. Its appearance in all subject combinations shows that the Teaching/Learning/Evaluation of chemistry is to be taken seriously. The subject combinations for the second cycle sciences have been grouped traditionally into four Series (S1, S2, S3 & S4) of three subjects each (in bold) to which one or two other subjects could be added depending on the ability of the student and the career to pursue.

N°	S1	S2	S3	S4
1	**Maths with Mechanics**	**Biology**	**Biology**	**Biology**
2	**Chemistry**	**Chemistry**	**Chemistry**	**Chemistry**
3	**Physics**	**Physics**	**Mathematics with Statistics**	**Geology**
4	Further Mathematics	Mathematics with Mechanics	Food Science & Nutrition	Physics
5	Computer Science	Further Mathematics	ICT	Mathematics with Statistics

In addition to the above main subjects, students would have to do some of the following enabling subjects: General English Language, General French Language, Sports and Physical Education, Manual labour and Citizenship Education; one period a week each, depending on their main subject total load.

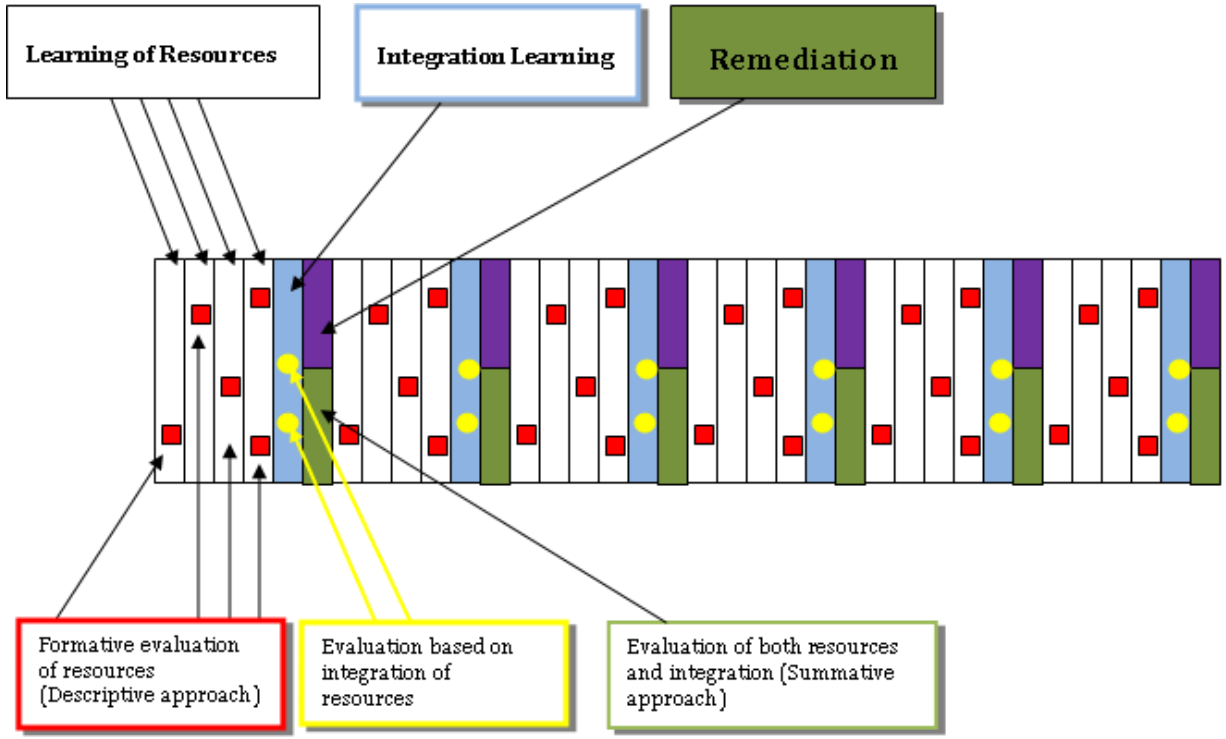
The Table below shows some plausible career opportunities for each of the series or subject combinations.

SERIES	S1	S2	S3	S4
CARRER OPPORTUNITIES	✓ Aeronautics ✓ Aerospace engineering ✓ Biomedical engineering ✓ Chemical engineering ✓ Civil engineering ✓ Computer engineering ✓ Electrical engineering ✓ Industrial engineering ✓ Mechanical engineering ✓ Military ✓ Nuclear engineering ✓ Petroleum engineering ✓ Renewable energy engineering ✓ Scientific researcher ✓ Software engineering ✓ Teaching ✓ Telecommunication engineering	✓ Agricultural engineering ✓ Anaesthesiology ✓ Biomedical engineering ✓ Biotechnology ✓ Epidemiology ✓ Forestry ✓ Laboratory technology ✓ Medicine ✓ Midwifery ✓ Military ✓ Nursing ✓ Petroleum engineering ✓ Pharmacy ✓ Radiology ✓ Scientific researcher ✓ Teaching ✓ Telecommunication engineering ✓ Veterinary medicine	✓ Agricultural engineering ✓ Agricultural science ✓ Anaesthesiology ✓ Biotechnology ✓ Chemical engineering ✓ Food technology ✓ Forestry ✓ Laboratory technology ✓ Medicine ✓ Midwifery ✓ Military ✓ Nursing ✓ Pharmacy ✓ Statistician ✓ Teaching ✓ Veterinary medicine	✓ Agricultural engineering ✓ Biotechnology ✓ Civil engineering ✓ Geological mining ✓ Geological research ✓ Geotechnical engineering ✓ Laboratory technology ✓ Midwifery ✓ Military ✓ Mining engineering ✓ Nursing ✓ Petroleum engineering ✓ Soil Scientist ✓ Teaching

Planning of Teaching/Learning and Evaluation

In Cameroon, the academic year is subdivided into six sequences of six weeks each. This is equivalent to three terms, each term having twelve weeks. Teaching/Learning and Evaluation take place in every sequence and comprises *Learning of Resources*, *Integration Learning* and *Remediation*, followed by Summative Evaluation. In each of the three stages of the Teaching/Learning process, formative evaluation is involved.

The diagram below is an example of how Teaching/Learning and Evaluation can be planned over a period of one school year.



The first four weeks could be consecrated to the teaching/learning of resources (knowledge and know-how), interspersed by formative evaluation of the descriptive type. That is, during this period of teaching/learning, we ought to develop oral questions, written application exercises for practice, homework, which may not be scored.

The fifth week could be consecrated to the integration of learning activities, which can take the form of experimental exercises or tutorials accompanied by appropriate remedial actions. This should be after a set of lessons that constitutes a topic or a significant part of a topic.

The sixth or last week of the sequence could be consecrated to remediation or revision to surmount possible difficulties or misunderstanding of learners, followed by graded evaluation of resources and competencies (end-of-sequence evaluation). It should be noted that this end-of-sequence evaluation should be essentially formative in nature, which implies that it should also be used to diagnose the lapses in learning with the view of providing appropriate remedies.

GENERAL PRESENTATION OF MODULES

The government of Cameroon, through the Inspectorate General of Education in the Ministry of Secondary Education, within the framework of an emerging Cameroon in the year 2035, has scheduled the pedagogic work to be done in the Sciences in Secondary Education into six modules, as in the table below:

S/N	TITLE OF MODULE	DISCIPLINES
Module I	The Living World	Biology, Geology, Mathematics.
Module II	Matter: Properties and Transformation	Chemistry, Physics, Biology, Geology, Mathematics.
Module III	Energy: Applications and Uses	Chemistry, Physics, Biology, Geology, Mathematics.
Module IV	Health Education	Biology, Chemistry, Mathematics.
Module V	Technology	Physics, Biology, Chemistry, Geology, Mathematics.
Module VI	Environmental Education and Sustainable Development	Biology, Chemistry, Physics, Geology, Mathematics.

The study of Science is holistic and it is actually not easy to show distinct boundaries between the disciplines and the modules proposed. Each discipline thus considers its subject matter and aligns it with the relevant module(s). For convenience, the subject matter in chemistry is covered under the modules II, III and VI; while aspects of 'Technology', 'Health Education' and 'The Living World' are considered therein.

MODULE II: MATTER: PROPERTIES AND TRANSFORMATION

1. TIME ALLOCATION: 440 (270 + 170) PERIODS (367 HOURS)

2. GENERAL PRESENTATION

Most of the core content of Chemistry in LSS and USS comprises matter, its characteristics and some reactions (i.e. transformation).This module consists of the following topics:

- The Mole Concept. ***
- Atomic Structure and Related Patterns in the Periodic Table.
- Bonding and Structure, and intermolecular forces.
- Organic Chemistry 1: Fundamentals and the chemistry of hydrocarbons.
- Descriptive inorganic Chemistry: Modern Periodic Table, Periodicity and s-block elements.
- Phase Equilibria and Raoult's law.
- Equilibria: Chemical Equilibria, Redox Equilibria, Acid-Base Equilibria.
- Organic Chemistry 2: Study of other organic compounds (functional groups).
- Descriptive inorganic Chemistry: Halogens, Group IV (14), d-Block Metals.
- Reaction Kinetics.
- Organic Chemistry 3: Reaction mechanisms and Synthetic routes.

*** ***The mole concept provides the mathematical tool in chemistry and is one of the topics that cut across all the modules.***

After looking at some basic notions of matter in Forms 1 - 5, more emphasis is laid on the properties and transformation of matter. In this regard the atom, the Periodic Table, bonding and structure, and the chemistry of the elements are then studied in more detail. Notions of quantitative chemistry (mole concept) and organic chemistry are studied in more detail, with transformations being represented by appropriate equations; without neglecting chemistry in society. To achieve this, the teacher has to sharpen the curiosity of the learner in such a way as to permit him/her to recognise, describe and interpret some phenomena that occur in his/her environment on a daily basis, to use the knowledge acquired to solve daily-life challenges; and also to carryout, observe and interpret simple chemical reactions.

3. CONTRIBUTION OF THE MODULE TO THE GOALS AND OBJECTIVES OF THE CURRICULUM

This module seeks to deepen the understanding of the learner of materials after the preliminary knowledge in chemistry acquired during the first five years of Secondary General Education.

4. CONTRIBUTION OF THE MODULE TO THE CURRICULUM AND TO AREAS OF LIFE.

To enable learners improve on their relationship with the material world, the teacher should stimulate the learners in such a way as to enhance their abilities to read, calculate, manipulate, estimate and interpret.
To achieve this, the learner needs skills in languages (English and French), Mathematics, Physics, Biology and Technology.
In this module, the learner is required to make decisions that affect his/her health, physical and social environments.

MODULE III: ENERGY: APPLICATIONS AND USES

1. TIME ALLOCATION: 68 PERIODS (57 HOURS)

2. GENERAL PRESENTATION

This module presents basic concepts in energy based on the Principles of Chemistry already introduced in the first cycle, with emphasis on heat and electricity. It is subdivided into two topics as follows:

- Thermochemistry/Energetics.
- Equilibria: Redox Equilibria.

3. CONTRIBUTION OF THE MODULE TO THE GOALS AND OBJECTIVES OF THE CURRICULUM

The study of energy helps in the construction of reasoning and familiarity with resources around us. The study of energy will enable the learner to develop the ability to visualise, interpret, justify, classify, clarify, appreciate, quantify, project, and describe the world through the availability of the different energy resources, their location, and relationships. This will also develop in the learner the spirit of initiative, creativity and enterprise. All these competencies enable the learner to become autonomous and independent to carryout different activities in the environment.

4. CONTRIBUTION OF THE MODULE TO THE PROGRAM OF STUDY AND TO THE AREAS OF LIFE

The content of this module has as objective to reinforce the capacity of the learner in carrying out research and integrating himself/herself into the social milieu. On the other hand, this module initiates the learner into project development and enables him/her to acquire knowledge of technological and methodological approaches. The acquisition of this scientific knowledge will need aspects of Mathematics, Physics, Geography, Information & Computer Technology, etc.
In this module the basic notions of energy are given, how it is generated, handled and used. This calls on the learner to make reference to daily actions vis-a-vis the energy in the following areas of life: media and communication, social and family life, citizenship, health care, environmental protection, welfare and economic life.

MODULE VI: ENVIRONMENTAL EDUCATION AND SUSTAINABLE DEVELOPMENT

1. TIME ALLOCATION: 32 PERIODS (26 HOURS)

2. GENERAL PRESENTATION

This module takes into consideration the notion of chemistry in the society and handles extraction of metals and heavy chemical industries; and comprises two topics as follows:

- Chemistry and Society: Aluminium, Nitrogen and Sulphur.
- Pollution from organic compounds.

The industrial preparation processes involved eliminate various waste products and the disposal of these products needs to be handled with care, as waste disposal has become a serious environmental hazard within the last few years. It is necessary to create awareness in learners as to the presence of these waste products and to sensitise them on the challenges of their sustainable management.

The treatment of the proposed family of situations in this module should help learners acquire investigative skills, refine their observation skills, implement techniques of data collection and organization, as well as methods of quantitative and qualitative data analysis, to help them adopt responsible behaviour concerning the protection of their environment. The treatment of the families of situations also ought to help learners to take note of the evolving nature of solutions related to the challenges faced in our environment.

3. CONTRIBUTION OF THE MODULE TO THE GOAL AND OBJECTIVES OF THE CURRICULUM

The skills the learner will acquire in this module will better equip him/her to sustainably manage his/her environment. This module would also invoke the love for careers like medicine, agronomy, teaching environmental education, etc.

4. CONTRIBUTION OF THE MODULE TO THE PROGRAMME OF STUDY AND TO AREAS OF LIFE

This module will develop in the learner skills linked to communication and interpersonal relations, decision making, critical thinking, scientific mind, self-esteem. These skills are indispensable in all the science subjects and other areas of learning.

This module also provides essential resources for the appropriation of the content on environmental education and sustainable development, health education and safety considerations.

The importance of this module lies in the fact that the learner, who permanently lives in a more or less hostile environment whereby the different natural resources are a source of socio-economic challenges, should know that only sustainable management of these resources can lead not only to a comfortable life but also to social peace. The family, social and economic life, the environment, well-being and health depend on man's behaviour in his environment.

COMPREHENSIVE TABLE SHOWING THE MODULES FOR LSS AND USS

The Competency-Based Approach (CBA) paradigm requires that the syllabus be written in modules. The syllabus for these two last years of Secondary General Education in Chemistry comprises three of the six modules in Science and Technology (Matter: Properties and Transformation, Energy and Environmental Education and Sustainable development); having thirteen main topics: seven in LSS and six in USS.

a) The modules:

Cycle	**Level**	**Title of module**	**Topic**	**Family of situations**	**Duration/Periods** (Hours)	
					Theory	**Practicals**
Second Cycle	**LSS**	Matter: Properties and Transformation	**1.** The Mole Concept.	Amount of substance.	36	54
			2. Atomic Structure and Related Patterns in the Periodic Table.	Atomic structure.	42	
			3. Bonding and Structure, and intermolecular forces.	Bonding and structure. Binding forces in substances.	36	
			4. Organic Chemistry 1: Fundamentals and the chemistry of Hydrocarbons.	Studying organic carbon compounds.	48	
		Energy	**5.** Thermochemistry/Energetics	Energy changes accompanying chemical reactions.	36	
		Matter: Properties and Transformation	**6.** Descriptive inorganic Chemistry: Modern Periodic Table, Periodicity and s-block elements.	The Modern Periodic Table. Periodicity. Chemistry of the s-block elements.	36	
			7. Phase Equilibria and Raoult's law.	Phase equilibria.	36	
	TOTAL				**270** (225)	**54** (45)
	USS	Matter: Properties and Transformation	**8.** Equilibria			54
			Chemical Equilibria	Chemical Equilibria	24	
		Energy	Redox Equilibria	Redox Equilibria	32	
		Matter: Properties and Transformation	Acid-Base Equilibria	Acid-Base Equilibria	24	
		Matter: Properties and Transformation	**9.** Organic Chemistry 2: Study of other organic compounds (functional groups)	Studying organic carbon compounds.	54	
			10. Organic Chemistry 3: Reaction mechanisms and synthetic routes.	Reaction mechanisms and reactivity. Studying organic carbon compounds.	12	
			11. Descriptive inorganic Chemistry: Halogens, Group IV (14), d-Block Metals.	Chemistry of the elements.	68	
			12. Reaction Kinetics.	Rates of chemical reactions.	24	
		Environmental Education and Sustainable development.	**13.** Chemistry and Society: Aluminium, Nitrogen and Sulphur. Pollution from organic compounds and heavy chemicals.	Chemistry and the environment. Extraction of metals. Petrochemical industry.	32	
	TOTAL				**270** (225)	**54** (45)
GRAND TOTAL					**540** (450)	**108** (90)

b) The matrix: The table is made up of three major columns:

- The **Contextual framewo**rk embodies the families of situations and examples of real life situations where the knowledge and skills (competencies) can be applied.
- The **Competencies** are made up of categories of actions and examples of actions: These are groups of some actions which are related to the mastery of the competencies expected for the module.
- The **Resources** have the essential or core knowledge which gives all the set of cognitive and affective resources which the learner needs to mobilize to successfully treat a family of situations. It is divided into four components: the subject content, the aptitudes (skills or know-how), attitudes to be disposed or displayed as well as other resources (material, human, finances, etc.) necessary for the acquisition of the competencies.

c) Competencies: The table below shows the various competencies to be acquired at the end of each topic and consequently by the end of the cycle. The teacher is expected to use the resources available in his/her local environments to impact/enhance these competencies unto the learners.

Cycle	Level	Title of module	Topic	Competencies
Second Cycle	**LSS**	Matter: Properties and Transformation	**1.** The Mole Concept.	Master simple definitions. Do calculations on the mole and related quantities, empirical and molecular formulae, percentage yields, gas laws, etc. Prepare standard solutions, carry out acid-base/redox reactions and titrations, write balanced equations and do calculations using chemical equations.
			2. Atomic Structure and Related Patterns in the Periodic Table.	Master simple definitions. Have experimental evidence for the existence and characteristics of sub-atomic particles. Describe functioning and use of the mass spectrometer. Know radioactive emissions, their properties and uses. Describe atomic absorption and emission spectra of the hydrogen atom and the experimental determination of ionisation energy. Use ionisation energies to explain existence of shells and sub-shells. Write electronic configuration from building up principle.
			3. Bonding and Structure, and intermolecular forces.	Master simple definitions. Identify forces that hold particles together in substances. Use dot and cross diagrams to explain bond formation. Relate properties of substances to bond type. Understand notion of sigma-bonds and pi- bond and hybridisation. State and explain the shapes of simple molecules. State and explain the different types of intermolecular forces and predict their effect on the physical properties of substances. Draw crystal structures. Describe X-ray diffraction by crystals. Distinguish between ionic and covalent solids using unit cells. Classify solids into bcc, fcc crystals or ccp and hcp crystals.
			4. Organic Chemistry 1: Fundamentals and the chemistry of hydrocarbons.	Master some definitions and concepts. Classify organic compounds. Construct molecular models. Name organic compounds using IUPAC rules. Identify elements in organic compounds. List functional groups

Cycle	Level	Title of module	Topic	Competencies
				and describe/carry out laboratory tests to identify or distinguish between them in given compounds. State and distinguish the various types of isomerism. Discuss methods of purifying organic compounds Determine purity of organic compounds. Identify petroleum as source of alkanes and aromatic hydrocarbons. Review petroleum distillation, cracking, and reforming. State the general molecular formulae of alkanes, alkenes, alkynes and aromatic hydrocarbons. Write out reaction mechanisms for different types of organic reactions. State different pollutants and environmental hazards.
		Energy	**5.** Thermochemistry and Enthalpy Changes (Energetics).	Master definitions and laws. Draw and interpret thermochemical energy level diagrams. Determine energy changes experimentally. Calculate enthalpy changes of reactions using Hess's law. Compare and interpret theoretical and experimental energy values in ionic models. Establish the relationship between solution, hydration and lattice enthalpies. Identify the different sources of energy (renewable and non-renewable).
		Matter: Properties and Transformation	**6.** Descriptive inorganic Chemistry: Modern Periodic Table, Periodicity and s-block elements.	Master definitions. Place the first 20 elements of the Periodic Table into groups and periods. Give family names to some groups of elements. Group the elements into metals, metalloids and non-metals. Place elements into various blocks in the periodic table. Discuss physical properties and relative reactivity of families. Carry out the reactions of Li, Na, K, Rb and Cs with cold water and oxygen. Prepare hydroxides, halides, sulphates, nitrates and carbonates of Group I and II elements. Investigate the effect of heat and water on hydroxides, halides, sulphates, nitrates, carbonates of Groups I and II elements. Carry out flame tests on some s-block elements. Describe the preparation of s-block chlorides, oxides and hydrides.
			7. Phase Equilibria and Raoult's law.	Master definitions. State Raoult's law. Draw and interpret phase diagrams for ideal and non-ideal mixtures. State characteristics of ideal and non-ideal mixtures with examples. Apply fractional distillation as a method of separating ideal mixtures. Calculate mole fraction and vapour pressure of components. List some methods used to separate non-ideal (azeotropic) mixtures. State the Partition law.
	USS	Matter: Properties and Transformation	**8.** Equilibria	
			Chemical Equilibria	Master definitions. State the equilibrium law and write the mathematical expression for the law. Calculate equilibrium constants (K_c, K_p, K_w, K_{sp}). State Le Chatelier's principle and explain how various factors (concentration, pressure, temperature, catalyst) affect the equilibrium position.

Cycle	Level	Title of module	Topic		Competencies
		Energy		Redox Equilibria	Master definitions. Write and balance redox reactions in aqueous and acidic media. Draw the Daniell cell. Calculate cell e.m.f.s . Define corrosion and state some methods of prevention. State some applications of redox reactions.
		Matter: Properties and Transformation		Acid-Base Equilibria	Recall and master definitions. Compare strengths of acids and bases. State and calculate equilibrium constants (Ka, Kb). Calculate pH values of strong and weak acids/bases and buffers. Calculate the composition of buffers. Perform acid-base titrations, draw and interpret titration curves. Explain how indicators function and choose appropriate indicators for titrations. Brief study of Buffer solutions.
		Matter: Properties and Transformation	**9.**	Descriptive inorganic Chemistry:	
				Halogens	List the elements and their variation in physical properties. Write their electronic configurations. Prepare the elements and halides. Draw an oxidation number chart for the halogens. Perform tests for halide ions and displacement reactions of one halogen by another. -Illustrate the disproportionation of chlorine and bromine in solution. Describe the reactions of halogens with non-metals, water, alkalis and other compounds. State the effects of CFCs on the ozone layer.
				Group IV (14)	-List the elements; Write electronic configurations. Draw the structures of diamond and graphite. State the unique properties of carbon. Explain/define catenation, allotropy, enantiomorphy using appropriate examples. Outline trends in reactivity from C to Pb. Use inert-pair effects to explain relative stabilities of compounds. -Describe the preparation and properties of hydrides, chlorides, dichlorides and oxides.
				d-Block Metals	Master simple definitions. Write the electronic configurations (*spdf* and electron-in-boxes) of the first transition metal series. Distinguish between a d-block element and a transition element. List specific characteristics of transition metals. Give and explain the trend in some physical properties across the first transition metal series. List the types of ligands and types of complexes. Carry out simple experiments to investigate the stoichiometry of a complex ion. State the various types of isomerism in complexes. Give importance of d-block elements and compounds.
			10.	Reaction Kinetics	Master definitions. State and explain factors that affect rate of reaction. State and explain the techniques for monitoring the rates of reactions.

Cycle	Level	Title of module	Topic	Competencies
				Carry out specific experiments to measure the rates of some simple chemical reactions. Plot rate curves. Determine experimentally and graphically orders of reactions. Suggest reaction mechanisms. Explain the theories of reaction rates. List the types of catalysis with concrete examples, explaining how a catalyst functions.
		Matter: Properties and Transformation	**11.** Organic Chemistry 2: Study of other organic compounds (functional groups).	Write the general molecular and structural formulae, name members of various homologous series, classify alcohols and halogenoalkanes into 1^o, 2^o and 3^o. State the methods of preparation and reactions of members of each homologous series, and carry out distinguishing tests. Describe interconversion reactions of functional groups (synthetic routes) ascending and descending the carbon chain, laying emphasis on the reagents, reaction conditions and observable changes. Give a brief account of polymerisation (addition and condensation).
			12. Organic Chemistry 3: Reaction mechanisms and synthetic routes.	Define reaction mechanism. State the various types of bond breakage and their respective outcomes. Define inductive, resonance (mesomeric) and steric effect and explain how they affect the reactivity of a compound with examples. State the various types of organic reactions, and using suitable examples in each case, show the mechanisms and reaction conditions involved.
		Environmental Education	**13.** Chemistry and Society: Aluminium, Nitrogen and Sulphur. Pollution from organic compounds and heavy chemicals.	Describe the extraction of aluminium, industrial preparation of sulphuric acid and ammonia and state their uses. Identify some nitrogenous and non-nitrogenous fertilizers. State some environmental problems related to the use of fertilizers. Carry out simple experiments to investigate the reactions of nitric acid and Cu, H_2S, I^-, Fe^{2+}.

The above competencies can be regrouped into the following major competencies:

- **Apply the scientific approach (scientific reasoning) in problem solving;**
- **Logical explanation of phenomena;**
- **Communicate using scientific knowledge;**
- **Make, manufacture or produce some useful objects/materials using the know-how acquired.**
- **Manage the environment in a sustainable manner.**

LOWER SIXTH

GENERAL CHEMISTRY

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
1. THE MOLE CONCEPT							
Amount of substance.	-Measuring quantities of solid substances. -Estimating quantities of substances in solution. -Measuring quantities of substances in gases. -Preparing solutions and estimating reacting quantities of substances. -Equations of reacting substances and stoichiometry.	-Defining terms. -Stating laws and deriving formulae. -Calculations. -Writing and balancing equations. -Weighing and comparing quantities of substances. -Reading and using of different equipment for measurements. -Preparing solutions. -Titrations. -Experimentation.	-Master simple definitions: mole, Avogadro Constant, relative atomic mass, RMM, molar mass, empirical formula, etc. -Write and balance equations. -Calculate the number of moles and particles. -Use relationship between mole and Avogadro constant. -Calculate percentage composition of elements in compounds. -Calculate empirical and molecular formulae. -Do calculations involving gas laws. - Determine molar masses of volatile liquids experimentally. -Set up and carry out simple experiments to demonstrate gas laws. -Determine limiting reagents and percentage yields of reactions. -Express concentrations in different units. -Prepare standard solutions and carry out acid-base titrations. -Standardise solutions (titrations). -Perform calculations	**1. THE MOLE CONCEPT** **1.1.Relative atomic mass:** Amount of substance: The mole; definition, Avogadro's constant, *L*; Molar mass: definition and related calculations. **1.2. Empirical formula of simple organic compounds:** Calculation of percentage composition. Molar constants and molar quantities e.g. Boltzmann constant, Avogadro's constant, molar gas constant, Faraday constant, molar mass, molar gas volume at s.t.p., molar heat capacity, etc. **1.3. Gas laws:** Boyle's and Charles's laws, the combined or Ideal Gas Law. Experimental determination of the molar mass of a volatile liquid. Percentage composition. **1.4. Concentrations** of homogeneous solutions in mol dm^{-3} and mass concentrations. Calculations relating to reactions in solutions. **1.5. Interpretation of chemical equations:** molar interpretation and molecular interpretation. Equations of reactions should include: a) Solids: e.g. heating $CaCO_3$, $ZnCO_3$. b) Gaseous reactions:e.g.$H_{2(g)} + Cl_{2(g)}$ c) Gas – solid reactions: e.g. $2KClO_{3(s)} \rightarrow 2KCl_{(s)} + 3O_{2(g)}$ d) Solutions: e.g. acid-base titrations, back titration. **1.6. Calculations and redox reactions:** Calculations involving masses of reactants and products (and	-Explain the mole concept and Avogadro's constant. -Calculate molar masses. -Calculate the number of particles in a given amount of a substance. -Calculate the percentage composition of elements present in a compound. -Calculate empirical formulae. -Calculate the concentrations of solutions. -Calculate the percentage yield of a reaction. -Use other molar constants in calculations. -State and apply Boyle's, Charles's and the Ideal Gas Laws. -Determine experimentally the molar mass of a volatile liquid. -Perform calculations using chemical equations. -Use data from qualitative chemical analysis to calculate	-Curiosity. -Observe lab safety rules. -Keen observation. -Appreciate each other's opinions. -Diligence in balancing equations and calculations. -Accuracy in preparing solutions and titrations. -Care in handling lab equipments.	-Calculators. -Balance. -Heat source. -Volumetric flask. -Reagent bottles. -Acids. -Bases. -Distilled water. -Indicators. -Burettes. -Pipettes. -Conical flasks. -Clamps and stands. -syringes. -Thermometers. -Barometer. -Steam jacket. -etc.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
			using chemical equations. -Write balanced equations for acid-base/redox titration reactions. -Do calculations based on titre values. -Interpret chemical equations. - Distinguish and give differences between normal and molar solutions. -Distinguish between molarity and normality.	limiting reagents) for gaseous, solid, homogeneous and heterogeneous reactions. Percentage yield. Calculations in acid-base titrations and redox reactions. Oxidation numbers. Balancing of redox equations: use molar method.	the concentration of a solution or the purity of a sample. -Write balanced redox equations and interpret chemical equations.		
2. ATOMIC STRUCTURE (AND) RELATED PATTERNS IN THE PERIODIC TABLE.							
Atomic structure	- Composition of the atom and properties of sub-atomic particles. -Radioactivity. -Mass spectrometry. -Atomic absorption and emission spectroscopy. -Ionisation energy. -Quantum shells and numbers. -Electronic configuration and the Periodic Table. -Shapes of orbitals. - Nuclei that were used in	-Defining terms. -Identifying sub-atomic particles. -Describing experiments. -Interpretation of spectra. -Writing electronic configurations.	-Master simple definitions. -Describe experiments that led to the discovery of sub-atomic particles. -State characteristics of sub-atomic particles. -Describe functioning of the mass spectrometer. -Interpret mass spectra (RAM, RMM). -Determine structures from fragmentation patterns. -Explain nature and properties of radioactive emissions. -Do calculations using half-lives and decay curves. -State some uses of radioactivity. -Describe atomic absorption and emission spectra of the hydrogen atom.	**2.1. The atom:** Ideas introduced at O/Level. Sub atomic particles: electrons, protons, neutrons; properties of each particle. Electron: brief description of discovery (J.J. Thomson Cathode-ray tube). Proton: Brief description of discovery. Nucleus: Rutherford, Geiger (gold-foil experiment); Model of atom: Bohr atom. Neutron: Brief history of discovery. Mosely, Chadwick (Bombardment of Be with α-particles). Mass number, Atomic number, Nucleus (symbol). Relative atomic masses, Isotopes and isotopic abundances. **2.2. Mass spectrometer:** Functioning and uses. Interpretation of mass spectrum data for elements and simple organic substances. Suitable examples and calculations. **2.3. Radioactivity**: nature of alpha(α), beta (β) and gamma (γ) radiation,	-Outline the historical developments that have led to our modern knowledge of the structure of the atom (Thomson, Rutherford, Chadwick). -Describe the three fundamental particles of an atom in terms of their relative masses and charges. -Describe the nature and properties of alpha, beta and gamma radiations. -Write equations for nuclear transformations. -Discuss the uses of natural radioactivity. -Indicate the dangers associated with radioactivity. -Explain the terms:	-Curiosity. -Awareness of electronic structure of atoms. -Devotedness, steadiness and keenness. -Carefulness in drawing. -Patience to observe maps and spectra.	-Periodic Table chart of the elements. -Mass spectra charts. -Graph papers. -Calculators. -Plasticines -Bold makers. -A pair of compass. -Pencil and eraser. -Pins. -Card board or A4 paper. -Diagrams of emission spectra. -Diagrams of mass spectrometer. -Diagrams of mass spectra. -Software of virtual

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
	the atomic bombs in Japan (equations).		-Determine ionisation energy experimentally. -Use ionisation energies to explain existence of shells and sub-shells. -Write electronic configuration from building up principle. -Describe atomic orbitals.	and properties of each. Uses and dangers of radioactivity and radioactive isotopes. **2.4. The electronic structure of atoms:** Introduction, Electromagnetic spectrum, continuous and discrete radiation. Spectra: atomic absorption and emission spectra. **2.5. Atomic emission spectrum of hydrogen:** Lyman, Balmer, Paschen series. The atomic spectrum of hydrogen as experimental evidence for energy levels: energy shells, n = 1, 2, 3, etc. Convergence limits→ionisation energy Ionisation energies: definitions of first ionisation energy, second ionisation energy. **2.6. Experimental evidence of ionisation energy** e.g. atomic spectra and electron impact method, multiple ionisation potentials. Calculation of ionisation energy ($\Delta E = h\nu$). Successive ionisation energies e.g. for sodium leading to electron shells (2.8.1) and subshells (1s, 2s, 2p...). First ionisation energy in relation to the periodic table: plot of first ionisation energy against atomic number of the first twenty elements (atomic number1-20) leading to existence of sub-energy levels. Bohr atom: quantum shells K,L,M,N and quantum numbers n,1, m, s. **2.7. Building up principle and electron configuration** in relation to the periodic table up to krypton (mention Aufbau principle, Pauli	mass number, atomic number, isotope, isotopic abundance and relative atomic mass. -Outline the main features of a mass spectrometer. -Calculate the relative atomic mass of an element given relative masses and abundances of isotopes. -Interpret a simple mass spectrum of an element. -Describe the atomic emission spectrum of hydrogen. -Define ionisation energy. -Describe a method for the determination of the first ionisation energy. - Use of radioactive dating to determine age of artefacts. -Indicate how atomic spectra and ionisation energies provide evidence for the electronic structure of atoms. -Describe the number and relative energies of s, p and d-orbitals for the principal quantum numbers (The Bohr atom).		functioning of mass spectrometer. - Pictures of destruction by atomic bombs used in Hiroshima and Nagasaki. -etc.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				exclusion principle and Hund's rule):1s 2s 2p 3s…. **2.8. Description** of s-orbital, electron density, uncertainty principle; wave-particle duality, shape of p-orbital (simple treatment). **2.9. Electron affinity as converse of ionisation energy:** Definition and trends; across the periods and down the groups.	-Write the electronic configuration of an element given its atomic number. -Write the electronic configuration of an element given its successive ionisation energies. -Define electron affinity. -Give the periodic trends in ionisation energy and electron affinity.		
3. BONDING AND STRUCTURE, AND INTERMOLECULAR FORCES.							
Bonding and Structure	-Chemical bond types. -Intermediate bond types. -Shapes of simple molecules and ions. -Intermolecular forces. -Bonding, structure and physical properties. -Crystal structures.	-Defining terms. -Demonstrating formation of chemical bonds. -Explaining factors that affect the formation of bonds. -Choosing elements on the Periodic Table that can form various bonds. -Identifying structures. -Stating the properties of substances in relation to bond types and intermolecular forces. - Identifying solid crystals.	-Master simple definitions. -Identify forces that hold particles together in substances. -Use dot and cross diagrams to explain bond formation. -Draw crystal structures. -State the properties of substances in relation to bond type. -Draw diagrams depicting the formation of sigma-bonds and pi- bonds using orbitals. -Describe the hybridisation of carbon atom in ethane, ethene and ethyne. -Draw electron density maps for simple ionic and covalent species. -Describe bond polarization and state	**3.1. Types of chemical bonds:** Ionic, covalent and metallic bonds. Definition of a chemical bond. **3.1.1 The ionic bond:** Definition, formation (tendency to assume noble gas structure), simple compounds: dot and cross diagrams (only valence shell shown) for NaCl, Li_2O, CaO, $MgCl_2$. Factors that affect the formation of ionic compounds i.e. ionisation energy, electron affinity, lattice energy (definitions of the various energy terms). Very simple crystal structures: NaCl, ZnS, CsCl. Properties of ionic compounds. **3.1.2 Covalent bond:** Definition, formation, dot and cross diagrams for simple and multiple bonds: e.g. H_2, Cl_2, HCl, O_2, CH_4, C_2H_4, C_2H_2. Molecular orbitals for sigma and pie bonds i.e. overlap of *s*-*s*, *s*-p_x, and p_z-p_z orbitals.	-Explain the terms chemical bond, bond length, bond energy and valence electrons. -Outline the main features of the electronic theory of valency. -Describe briefly the nature and characteristics of: ionic bonds, covalent bonds, coordinate bonds, metallic bonding, hydrogen bonding, Van der Waals' forces and dipole-dipole attractions; and give examples of elements or compounds in which these types of bonds exist. -Deduce the type of	-Curiosity. -Keen observation. -awareness. -Develop orderliness in research and data presentations. -Exercise good listening, speaking, and writing attitudes.	-Periodic Table -Molecular models. -NaCl. -Iron, copper. -Water. -Ice. -Heat source. -Crystals. -etc.

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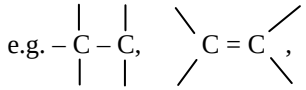
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
			factors affecting it. -State and explain the shapes of simple molecules. -State and explain the different types of intermolecular forces. -Predicting the effect of intermolecular forces on the physical properties of substances. -Describe X-ray diffraction by crystals. -Distinguish between ionic and covalent solids. -Draw the unit cells of some crystal structures . -Classify solids into b.c.c., f.c.c. crystals and into c.c.p. and h.c.p. crystals -Identify crystals using coordination numbers.	Hybrid orbitals: sp^3, sp^2, sp ; and corresponding examples: ethane, ethene and ethyne. Delocalized orbitals: benzene. Electron density maps for simple ionic and covalent species: NaCl, H_2, H_2^+. **3.1.3 Intermediate bond types:** Ionic character of covalent bonds (bond polarisation), covalent character of ionic bonds (ion polarisation): factors that lead to intermediate bond types in ionic and covalent compounds across the Periodic Table e.g. AgX, dipole moments. Multiple bonds and delocalisation e.g. C_2H_4, C_2H_2, NO_3^-, $CH_3CO_2^-$, SO_4^{2-}, C_6H_6. Resonance. **3.1.4.Metallic bond:** Description, simple picture and formation; effect on properties of metals. Definitions to include atomic volume, atomic radius, ionic radius, Van der Waals' radius, covalent radius, metallic radius, bond length. **3.2. Intermolecular forces:** Polarity of molecules. Concept of dipole moment (qualitative treatment only). Van der Waals' forces: role in crystals of noble gases and molecular crystals. Dipole-dipole attractions. Hydrogen bonding: comparison of strength with chemical bond and Van der Waals' interaction. Effects of H-bonds; Carboxylic acid dimers in gas and liquid phases and hydrated salts. Comparison of the properties of simple hydrides (CH_4, NH_3, H_2O, HF). Discussion of special case of water and ice.	bonding present in substances from information given. -Use the electron transfer model to show how ionic bonds are formed. -Show how ionisation energy and electron affinity influence the formation of ionic bonds. -Use dot/cross diagrams to represent ionic, covalent and co-ordinate bonding in simple elements and compounds. -Show how electronegativity influences the formation of ionic and covalent bonds. -Distinguish between the terms: bond length, Van der Waals' radius, covalent radius, metallic radius and ionic radius. -Predict and explain the shapes of simple molecules and ions using the valence shell electron-pair repulsion (VSEPR) theory. -Explain the differences in bond angles in methane, ammonia and water.		

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				Intermolecular forces and physical properties of liquids and solids: melting temperature, boiling temperature, latent heats, hardness, density. Physical property of substance related to its bonding and structure: include metals, simple molecules and giant structures. **3.3. Shapes of simple molecules and ions** (VSEPR theory)**:** Linear e.g. $BeCl_2$, CO_2, C_2H_2; Trigonal planar e.g. BF_3; Tetrahedral e.g. CH_4; Pyramidal e.g. NH_3, H_3O^+, PF_3; Bent e.g. H_2O, H_2S; Trigonal bipyramidal e.g. PCl_5; Octahedral e.g. SF_6, PF_6^-. Others: NO_3^-, $CH_3CO_2^-$, SO_4^{2-}. **3.4. Bonding, structure, physical properties:** State of matter, volatility (related to bonding), solubility, bond type and chemical properties. **3.5. Crystal structures.** Only simple examples to be treated. **3.5.1** X-ray diffraction by a crystal. Bragg's equation, X-ray goniometer, Electron density maps. Space lattice and unit cells. Unit cells and Avogadro's number. Classification of solids as ionic and covalent solids. Concept of symmetry. **3.5.2** Ionic solids. Classification of solids into body-centred cubic (b.c.c.) and face-centred cubic (f.c.c.) structures. Sodium chloride lattice, caesium chloride lattice. Coordination number in b.c.c. and f.c.c. crystals. **3.5.3** Covalent solids and molecular crystals. Classification of solids into	-Give examples of how bonding influences the physical structure of elements and compounds. -Indicate and give examples of how bond type influences the physical and chemical properties of elements and compounds. -Know the importance of X-ray diffraction in the determination of crystal structures. -Determine the Avogadro constant from X-ray diffraction. -Draw electron density maps of some simple compounds e.g. NaCl. -Contrast the properties of giant molecular, giant ionic and simple molecular crystals. -Define unit cell and coordination number w.r.t. crystal structures. -Classify ionic solids into body-centred cubic (b.c.c.) and face-centred cubic (f.c.c.) structures. -Classify solids into cubic close-packed (c.c.p.) and hexagonal close-packed (h.c.p.)		

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				cubic close-packed (c.c.p.) and hexagonal close-packed (h.c.p.) structures. Coordination number in c.c.p. and h.c.p. crystals. Structure of graphite, diamonds, buckminsterfullerenes.	structures giving examples. -Draw the structures of graphite, diamonds and buckminsterfullerenes.		
4.0 ORGANIC CHEMISTRY 1: FUNDAMENTALS AND THE CHEMISTRY OF HYDROCARBONS.							
Studying Organic carbon compounds.	-Classification. -Identification. -Purification. -Properties.	-Definitions. -Nomenclature. -Classification. -Descriptions. -Explanations. -Stating physical and chemical properties of the different homologous series - Drawing/sketching -Preparations. -Calculations. -Experimentation.	- Master definitions. -Construct molecular models to show covalent bonding and structure in simple alkanes, alkenes and alcohols (C1-C3). - Explain the peculiar behaviour of carbon. -Classify organic compounds. -Describe bonding in organic compounds. (Hybridization) - Show spatial distribution of bonds in examples of different classes of compounds e.g. alkanes, alkenes, alkynes and benzene. - Carry out laboratory reactions between alkenes and alkynes with some reagents like Br_2, $KMnO_4$, H_2SO_4, etc. - List the different functional groups. - Carry out simple laboratory tests for the identification of different functional groups. - Write the structural formulae of the different	**4.1.** What is organic chemistry? **4.1.1** The peculiar behaviour of carbon. **4.1.2** Saturated and unsaturated HCs. **4.2 Classification of organic compounds** **4.2.1** Acyclic (Aliphatic) or open-chain compounds. **4.2.1.1** Tetravalent carbon in saturated compounds and spatial distribution of bonds in aliphatic compounds; unbranched and branched chains, isomerism in butanes. **4.2.1.2** Unsaturated compounds: Double and triple bonds. Spatial distribution of bonds in ethane and ethyne. **4.2.1.3** Alicyclic or closed-chain or ring compounds: Cyclopentane, cyclohexane; cyclohexene. Shapes including non-planarity. Models of various molecules. **4.2.2** Aromatic compounds: Benzene and its derivatives. **4.2.3** Heterocyclic compounds: (Aromatic or alicyclic, having at least one element other than carbon in the ring. e.g. pyrrole, furan, pyridine, oxazole, thiophene, quinoline, etc.). **4.3. Functional groups and Homologous series:** **4.3.1** Concept of functional groups in	- State what organic chemistry is. -Distinguish between organic and inorganic chemistry. -Explain the uniqueness of carbon. - Describe typical bonding and molecular structures, and physical properties of carbon compounds. -Classify organic compounds. (Aliphatic, alicyclic, aromatic, polycylcic and heterocyclic compounds). - Write the names; molecular formulae and structural formulae of the first 06 members of the homologous series of: alkanes, alkenes and alkynes -Draw the structure of benzene and explain aromaticity. - Define functional group and homologous series.	-Ability to describe. -Keen observation. -Care in handling poisonous substances. -Care in handling chemicals. -Care in drawing structures. -Care in handling laboratory equipment. -Construct common cpds using the organic chemistry model. Should predict weak and strong bonds from models to show isomerism. - Guess some	-Organic models. -Bold markers. -Cardboard. -Alkanes (domestic gas). - Alkenes. - Bunsen burner.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
			functional groups. - List the characteristics of a homologous series. - State the various types of isomerism. - Name organic compounds using IUPAC and common names. - Discuss methods of purifying organic compounds. - Determine purity of organic compounds. - Carry out laboratory tests to identify some elements in organic compounds like C, H, O, N, S, Halogens. - Determine quantitatively the amount of each of the above elements in compounds. - Calculate empirical and molecular formulae. - Discuss different methods used in determining molecular mass. -Briefly describe how spectroscopic methods and X-ray diffraction are used to determine molecular structure. -State the bond cleavages that occur during organic reactions. -Write equations to show carbanion and carbocation formation. - State and explain factors	the above frameworks: e.g.  – C ≡ C – , –OH, – CHO, C = O, -CO_2H, -Hal, -NH_2, -NHR, -NR_2, -NO_2 . **4.3.2** Simple qualitative tests for the different functional groups. **4.4. Isomerism:** **4.4.1** Definitions: isomerism, isomers. **4.4.2** Structural isomerism: chain, position, functional group (Brief mention of tautomerism and metamerism). **4.4.3** Stereoisomerism: geometric (Cis-Trans), Optical (enantiomorphy; include racemic mixtures and methods of resolution), Conformational (only for cyclohexane and cyclohexanol). Idea of plane polarisation of light. **4.5. Nomenclature:** The IUPAC system. Systematic naming of simple organic compounds. **4.6 Determination of structures:** **4.6.1** Isolation techniques; Extraction, synthesis. **4.6.2** Methods of purifying organic compounds: Re-crystallisation, fractional crystallisation, sublimation, filtration, centrifugation, distillation, fractional distillation, steam distillation, solvent extraction (separating funnel), chromatography. **4.6.3** Criteria of purity: Use of physical properties like melting point,	- Carry out simple tests to identify and distinguish between different functional groups. - Distinguish between the terms structural isomers and Stereoisomers. -Explain and give examples of geometric isomerism and optical isomerism. -Explain the term optical activity. -Name and write the structures of common organic compounds. -Write the names of simple organic compounds given their structural formulae. -Outline the main methods of purification of organic compounds. -State the criteria for purity. - Determine empirical and molecular formulae from analytical data. -Relate the mass-to-charge ratio of the ion of an organic molecule to its peak in the mass spectrum of the compound. -State the bond	lower hydrocarbons by observing them during combustion.	

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
			affecting organic reactions. - Illustrate reaction mechanisms for different types of organic reactions. - Identify petroleum as source of alkanes and aromatic hydrocarbons. - Review petroleum distillation, cracking, and reforming. -Draw the fractionating column. -State the general molecular formulae of alkanes, alkenes, alkynes and aromatic hydrocarbons. -Give equations that show the laboratory preparation of saturated, unsaturated and aromatic hydrocarbons. -State their physical and chemical properties. -Compare the reactions of saturated and unsaturated compounds. -State the uses and importance of some members of the above homologous series. - Draw the Kekulé structures of benzene and illustrate how the true structure of benzene is more stable than that of Kekulé. - Carry/write out some	boiling point, etc. **4.6.4** Qualitative analysis of elements: for common elements, C, H, O, N, S, halogens (Brief discussion of Laissaigne's test). **4.6.5** Quantitative analysis: for the common elements listed above. **4.6.6** Empirical formula from analytical data. Molecular mass: review methods of determination e.g. vapour density, melting point depression, boiling point elevation, vapour pressure depression, mass spectrometry. Molecular formula and related calculations. **4.6.7** Deduction of molecular structure: from reactions of functional groups and physical properties. Brief description of spectroscopic methods in structure determination (U.V., I.R., N.M.R., mass spectroscopy, X-ray diffraction). Use information from spectroscopy to deduce structures of organic compounds. **4.7. Types of Organic Reactions** **4.7.1** Substrate and reagents. (Electrophiles and nucleophiles): Definitions and examples. **4.7.2** Types of reactions with examples: substitution, addition elimination, condensation. **4.7.3** Bond fission (cleavage, rupture): homolytic fission, heterolytic fission. Meaning of carbanion, carbocation (carbonium ions) **4.7.4** Factors influencing organic reactions: inductive effect, mesomeric effect, electrometric effect, steric	cleavages that occur during reactions. - Describe the typical reactions of saturated, unsaturated and aromatic hydrocarbons (case of benzene with bromine (halogenation), potassium permanganate, sulphuric acid/nitric acid (nitration), sulphonation , and Freidel Craft reaction. -Describe the typical reactions of saturated and unsaturated hydrocarbons. -Compare and give specific examples of the chemical properties of alkanes, alkenes, alkynes and arenes, particularly w.r.t.: i) combustion and other oxidation reactions; ii) reactions with halogens and halogen halides; iii) Hydration; iv) cracking. - Outline the main methods of preparing, and identifying of organic compounds -Write equations that show the laboratory preparation of saturated, unsaturated		

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
			laboratory reactions between benzene and some reagents like Br_2, $KMnO_4$, Cl_2, conc. H_2SO_4/conc. HNO_3, conc. H_2SO_4, $CH_3Cl/AlCl_3$. - Discuss the orientation of incoming groups in substituted benzene. - Polymerisation of styrene. - Outline the main methods of preparing, and identifying of organic compounds. - State the different pollutants and environmental hazards.	factors. **4.7.5** Reaction mechanisms (Brief mention of types, to be detailed during the course and/or in Topic 12) -Free-radical substitution. -Electrophilic addition and substitution. -Nucleophilic addition and substitution. **4.8. Chemistry of hydrocarbons** **4.8.1** Petroleum chemistry **4.8.2** Saturated HCs(Alkanes) **4.8.3** Unsaturated HCs (Alkenes and Alkynes). Characteristic properties of saturated and unsaturated hydrocarbons: Contrast reactions of the two (alkenes and alkynes) with Br_2, $KMnO_4$, H_2SO_4. Discuss the mechanism of each reaction. **4.8.4** Aromatic HCs e.g. Benzene: Stability of structure leading to aromatic character outweighing degree of unsaturation. Electronic structure and spatial distribution of bonds. Structure of benzene in terms of resonance of Kekulé forms. Simple reactions of benzene with Br_2, $KMnO_4$, Cl_2, conc.H_2SO_4/conc.HNO_3, conc. H_2SO_4, $CH_3Cl/AlCl_3$. Discuss the mechanism of each reaction. Orientation of incoming groups in substituted benzene. **4.9. Pollution from organic compounds** Sources of pollution and impact on the environment.	and aromatic hydrocarbons. -State their physical and chemical properties. -State the uses and importance of some members of the above homologous series. -State and define the different types of organic reactions and write out their mechanisms. -State and explain the factors affecting organic reactions. -Give an example each of free-radical substitution reaction, electophilic addition and electophilic substitution reactions.		
5.0. THERMOCHEMISTRY AND ENTHALPY CHANGE (ENERGETICS)							
Energetics. Thermochemistry	- Experimental determination of Enthalpy changes. - Calculations involving energy changes. -Energy	- Defining terms. - Stating some laws. -Measuring energy changes. - Calculating energy changes. - Experimentation. - Describing.	- Master definitions. -State the first law of thermodynamics. -Draw graphs to depict exothermic and endothermic reactions. -Determine experimentally enthalpy changes of reactions.	**5.1. Introduction:** Why the study of thermochemistry? Energy; energy changes; heat; temperature, specific heat and calculations. Definition of system and surrounding. Conservation of energy; work and energy change, units of each. Brief difference between internal	-Explain the terms: isolated system, state function, internal energy, heat, enthalpy, standard states, delocalised (resonance) energy, feasibility of reaction, useful work.	- Care in handling lab equipment. - Keen observation of temperature changes. - Respect of laboratory	- Thermometers. - Plastic cups. - Spirit lamps. - Windshields. - Ethanol. - Methanol. - HCl acid. - H_2SO_4 acid. - NaOH.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
	sources.	- Drawing, interpreting and comparing energy level diagrams. -Identifying energy sources.	- Calculate heat changes. - State Hess's law and use it in calculating enthalpy changes. - Draw and interpret energy diagrams. -Compare and interpret theoretical and experimental energy values in ionic models. -Determine stoichiometry of compounds from energy considerations. -Establish the relationship between solution, hydration and lattice enthalpies. - Identify the different sources of energy (renewable and non-renewable)	energy and enthalpy. Definition of standard conditions and standard enthalpies: ΔH^0, ΔH^0_f, $\Delta H_c{}^0$, $\Delta H_r{}^0$, ΔH^0_{neut}; Experimental method for finding the standard enthalpy of: Neutralisation, Combustion. Finding the enthalpy change for a reaction: Hess's law and applications. Finding $\Delta H_f{}^0$ of a compound indirectly. Finding the ΔH^0 of reaction using Hess's law. Combined temperature change and change of state problems. **5.2. Energetics of formation of covalent molecules:** Bond energy terms; determination of average bond energy terms (B.E.T) e.g.CH_4, C_6H_6. Use of bond energy terms (B.E.T) in simple organic molecules; average standard enthalpy of reaction from average standard bond enthalpies. Examples of the breakdown of the additive rule of bond energy terms for benzene bringing out importance of bond energy terms in understanding chemical bonding. Atomisation energy. **5.3. Energetics of formation of ionic crystals:** The Born-Haber cycle: NaCl, MgO, $MgCl_2$. Definition of lattice energy (L.E.). Application of Hess's law to determine lattice energy for simple ionic crystals. Simple model of ionic crystal and	-State the first law of thermodynamics. -Distinguish between the terms exothermic and endothermic. -Outline how the following can be determined experimentally: enthalpy of combustion, enthalpy of neutralisation and bond enthalpies. -Calculate from experimental data, the molar enthalpy of combustion and the molar enthalpy of formation. -State Hess's law and apply it to simple calculations of enthalpy changes. -Devise, interpret and use enthalpy diagrams. -Interpret and use bond enthalpy and lattice enthalpy. -Calculate lattice energies using the Born-Haber cycle. -Distinguish between the enthalpy of solution and the enthalpy of hydration. -Discuss the significance of the term entropy. -Discuss the various	safety rules. - Respect of experimental procedure. -Develop the culture of team work. -Reading thermometers (1^oC, 0.1^oC, 0.2^oC divisions) -Manipulation of stopwatch.	- NaCl. - $Na_2S_2O_3.5H_20$. - Calorimeters. - Beakers. - Heat source. - $CaCl_2$. - $Ba(OH)_2$. -NH_4Cl. -$AgNO_3$. - Book of data. - Thermos flask. - Hot water. - etc

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				theoretical values of lattice energy. Comparison of theoretical and experimental lattice energy for alkali halides and similar salts and for silver halides, AgX and zinc sulphide, ZnS leading to support of ionic intermediate bond type. "Driving Force" for the formation of ionic compounds and covalent compounds; Born-Haber cycle for MgCl and $MgCl_3$. **5.4. Solvation:** Energy changes involved when substances dissolve. Relationship of enthalpy of solution to lattice energy and hydration energy. **5.5. Energy sources:** renewable and non-renewable forms of energy.	sources of energy. available to man. -Distinguish between renewable and non-renewable forms of energy.		
6.0 DESCRIPTIVE INORGANIC CHEMISTRY: MODERN PERIODIC TABLE, PERIODICITY AND s-BLOCK ELEMENTS							
The Modern Periodic Table. Periodicity. Chemistry of the s-block elements.	-Historical development and contributions towards the modern Periodic Table. -Periodicity of elements with respect to bonding and structure, physical properties; and other atomic parameters. -Periodic relationships	-Definition of terms. -Grouping elements. -Discussions. -Naming some scientists and saying how they contributed to the development of the modern Periodic table. -Stating changes in properties of elements across the period and down the group. (Periodic and group trends)	-Master definitions. -Place the first 20 elements of the Periodic Table into groups and periods. -Group the elements into metals, metalloids and non-metals. -Place elements into various blocks in the Periodic Table. -Give family names to some groups of elements. -State the contributions of Dobereiner, Newlands,	**6.1. The long form of Periodic Table:** Brief discussion of stages of development which led to the modern Periodic Table: Dobereiner's triads; Newlands' octaves; … Periods, groups (also include system of numbering Groups l to 18), Metals, non-metals, and metalloids. **6.2. Periodicity (from Li to Ar):** Structure and bonding, physical properties; Bpt, Mpt. Atomic and ionic radii; Atomic number, enthalpies of fusion and vaporisation, densities; ionisation energy, electron affinity, electronegativity. Work based largely on data collected from literature. Interpretation of physical properties in terms of structure. (Ionisation energies as additional evidence of periodicity).	-Give a brief history of the modern Periodic Table (Dobereiner triads, Newlands octaves…). -Describe the principal features of the modern Periodic Table. -Give examples of: s-block, p-block elements and show where these elements are located in the Periodic Table. -Identify metals, non-metals and metalloids, giving examples of each type of element and giving physical properties. -Outline the periodicity of elements with respect to: (i) structure and bonding (ii) physical properties, including melting and	-Curiosity. -Care in handling Chemicals and equipment. -Keen observation. -Respect of laboratory safety rules. -Accuracy in making inferences and drawing conclusions. -Great care when heating substances.	-The modern Periodic Table chart. -Pictures of the contributors and their versions of the Periodic Table. -Chemicals (Li, Na, K, Rb, Cs, Be, Mg, Ca, Sr, Ba) -Cold water -Oxygen -HCl acid -HNO_3 acid -H_2SO_4 acid -NaOH

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
	among the oxides, chlorides and simple hydrides of elements of periods 2 & 3. -Comparative study of Groups I and II elements.	-Writing and balancing chemical equations. -Experimentation -Preparation of some compounds of Groups I and II elements. -Description of some processes, phenomena or reactions.	Meyer, and Mendeleev leading to the development of the modern Periodic Table. -Discuss physical properties and relative reactivity of families. -Carry out the reactions of Li, Na, K, Rb and Cs with cold water and oxygen. -Prepare hydroxides, halides, sulphates, nitrates and carbonates of Group I and II elements. -Investigate the effect of heat on hydroxides, halides, sulphates, nitrates and carbonates of Groups I and II elements. - Investigate the solubility of hydroxides, sulphates, carbonates, hydrogen carbonates and chlorides of Groups I and II elements. -Carry out flame tests on some s-block elements. -Describe the preparation of s-block chlorides, oxides and hydrides.	**6.3. Periodic relationships amongst the oxides, chlorides and simple hydrides of elements of periods 2&3 (Li to Cl):** Stoichiometric composition of oxides, chlorides and simple hydrides of elements of periods 2 & 3.This should include trends in compounds formation (i.e. ionic → covalent) and valency in period 3. Preparation of chlorides of period 3: methods linked to type of bonding. Neutralisation and direct combination. Reactions of oxides, chlorides, hydrides with water. Acid-base behaviour of oxides, hydrolytic behaviour of the chlorides and hydrides. Nature of bonding in chlorides and hydrides of Li to Cl and its effect on their chemical behaviour should be brought out. **6.4. Comparative study of the Groups I & II elements (s-Block):** Selected properties of elements Li, Na, K, Mg, Ca, Sr, Ba, should include: structure, physical properties, flame test, constant oxidation number, reactions with water, with non-metals, with acids. Properties of some of their important compounds should include: ionic character, solubility of carbonates, sulphates, halides, hydroxides, and thermal stability of the hydroxides, hydrogen carbonates, carbonates and nitrates. Account for stability (i.e. hydration energy factor and lattice energy, ion	boiling points, (iii) atomic and ionic radii, and density, (iv) ionisation energies, electron affinity and electronegativities. -Outline the periodicity of the elements with respect to chemical properties including (i) compound formation (oxides, hydrides), (ii) valency, (iii) oxidation state, (iv) redox properties (for periods 2 and 3 only). -Describe methods of preparation of chlorides of period 3. -Discuss the periodicity of chemical and physical properties of oxides, hydrides and chlorides of periods 2 and 3. -Give examples of diagonal relationships in periods 2 and 3 of the Periodic Table. Point to some anomalies in the Periodic Table. -Write the electronic configurations of Groups I and II metals. -Outline the main trends in the properties of these metals on descending Groups I and II. -Describe the general physical properties of metals in groups I and II. -Describe and account for the chemical reactivity of the s-block metals. -Give typical examples of		-Heat source -Matches -Bunsen burner -Test tubes -etc.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				size and ion charge). Anomalous properties of Li and Be (point out some anomalies in the Periodic Table), diagonal relationship.	the reactions of s-block metals with: non-metals, water and acids. -Briefly describe the structure and bonding, preparation, chemical and physical properties of the halides, carbonates, sulphates and hydroxides of the s-block metals. -Compare the reactivities of the Groups I and II metals, and their compounds. -Describe the trends in the thermal stabilities and solubilities of the following compounds of the s-block metals: nitrates, sulphates, carbonates and hydrogen carbonates. Give examples of the anomalous properties of lithium and beryllium.		
7.0 RAOULT'S LAW AND PHASE EQUILIBRIA							
EQUILIBRIA Phase Equilibria	One-component systems. Two-component systems. -Ideal solutions -Non-ideal solutions. -Separation techniques. -Partition of solute between two immiscible solvents.	-Defining terms. -Stating Laws. - Drawing and interpreting phase diagrams. -Explaining separation techniques.	-Master definitions. - State Raoult's law. - Draw and interpret phase diagrams for mixtures with; *One component two phases. *One component three phases. *Two components , two phases. (Laying emphasis on vapour pressure/ temperature Versus composition curves for ideal solutions and non-ideal solutions at constant temperature and pressure	**7.1. Equilibrium state:** static equilibrium, dynamic equilibrium (physical equilibrium, chemical equilibrium). **7.2. One-component systems:** apply the kinetic theory qualitatively to vapour-liquid equilibrium e.g. $Br_{2(g)}/Br_{2(l)}$, $H_2O_{(l)}/H_2O_{(g)}$. **7.3. Two-component systems:** confined to mixtures of two miscible liquids. Law of partial pressures: statement and calculations.	-Distinguish between the terms: (i) static equilibrium and dynamic equilibrium. (ii) phase equilibrium and chemical equilibrium. -Describe the main features of dynamic equilibria. -State and apply Dalton's laws of partial pressures and mole fraction.	-Care in handling Laboratory equipment and chemicals. -Diligence in drawing graphs. - Keen observation.	-Charts of phase diagrams. -A bottle of liquid Bromine. - Bunsen burner. - Ethanol, -water. -Ice. - Measuring cylinders. - Oil. - Calculators.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
			respectively) - State characteristics of ideal and non-ideal mixtures with examples. - Apply fractional distillation as a method of separating ideal mixtures. - Calculate vapour pressure, mole fraction for the components. -List methods used to separate non-ideal mixtures. -State the Partition law.	**7.3.1 Solutions:** Mole fraction: definition and calculations; statement of Raoult's law. **7.3.2 Ideal (systems) solutions:** kinetic molecular picture in terms of intermolecular forces. Vapour pressure-composition curves for ideal solution, temperature-composition curve for ideal solution, simple distillation and fractional distillation. Application: continuous fractional distillation of petroleum or crude oil (SONARA). **7.3.3 Non-ideal solutions:** Positive and negative deviations: explanation in terms of molecular interactions .Enthalpy changes on mixing. Vapour pressure-composition curves; Temperature-composition curves; Azeotropic systems: qualitative treatment only. **7.4. Non-miscible liquids:** steam distillation; distribution of a solute between two immiscible solvents; concept of dynamic equilibrium applied to this situation qualitatively.	-Describe and explain the variation of vapour pressure with temperature. -Define: a phase, a component. -Apply the kinetic theory to one-component systems. -Interpret phase diagrams of one- and two-component systems. -State Raoult's law and apply it to a system of two completely miscible liquids. -Explain the lowering of vapour pressure and the elevation of boiling point in terms of intermolecular forces. -Explain the basis of simple distillation and fractional distillation. -Describe the use of fractional distillation in SONARA and in the making of local gin (ARKI, AFOFO, HA). -Distinguish between zeotropic and azeotropic mixtures. -Explain the basis of steam distillation. -State the distribution law and discuss its limitations. -Describe the main features of solvent extraction.		-Graph papers. -etc.

UPPER SIXTH

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
8.0 EQUILIBRIA							
Chemical Equilibria.	- Equilibrium state. -Types of equilibrium. -The equilibrium law and equilibrium constants. -Le Chatelier's principle. -Factors affecting equilibrium.	-Definitions of terms. -Statements of laws. -Explanation of phenomena. -Calculations. -Prediction of reactions. -Experimentation.	-Master definitions. -State equilibrium law and its mathematical expression. -Calculate equilibrium constants (Kc, Kp). -State the relationship between Kc and Kp. -State Le Chatelier's principle. -State and explain factors affecting equilibrium position. -State the relationship between enthalpy change and equilibrium constant.	**8.1. CHEMICAL EQUILIBRIA** **8.1.1 Concept of reversibility:** introduction to equilibrium. Through a variety of examples bring out the concept of reversibility in: -Physical equilibrium. -Chemical equilibrium. The position of equilibrium leading to Le Chatelier's principle. Le Chatelier's principle: Common species effect. Factors affecting equilibrium position and state. The effect of conditions on position of equilibrium using reversible reactions: changes in concentrations, pressure, temperature. Examples of some systems that could be used to study the equilibrium state: -Physical equilibrium; vaporisation, Dissolution of $CuSO_4.5H_2O$. -Chemical equilibrium: Esterification of ester, Ester hydrolysis, Thermal dissociation of $CaCO_3$ in a closed system. **8.1.2 Properties which characterise the equilibrium state:** properties of equilibrium state, Relative concentration at equilibrium: concentrations of pure solids and pure liquids. The equilibrium law and equilibrium constants Kc and Kp (Examples of some equilibrium constants: Kc, Kp, Kw, Ka). -significance of equilibrium constant and factors affecting	-Bring out the concept of reversibility in: (i) physical equilibrium, (ii) chemical equilibrium in a closed system. -State the three characteristics of a system in chemical equilibrium. -Give examples of systems in chemical equilibrium (including aqueous, gases, water, weak acids). -State and explain the equilibrium law. -Calculate equilibrium constants. -Predict the effect of the following on the position of equilibrium and on equilibrium constant: (i) a change in the concentration of reactants or products; (ii) a change in applied pressure; (iii) a change in temperature; (iv) the presence of a catalyst.	-Ability to describe. -Keen observation. -Care in handling chemicals and equipment.	-Bromine. -NaOH. -Esters. -Ethanol. -Acetic acid. -HI. -HIO_3. -$CuSO_4.5H_2O$. - $CaCO_3$. -Distilled water. -Barometer. -Thermometer. -Calculator. -etc.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				equilibrium. -Homogeneous equilibria: gas phase equilibria. Relationship between temperature, enthalpy change and equilibrium constant.			
Redox Equilibria	-Redox reactions. -Redox potentials and their measurements: the Daniell cell. -Standard electrodes. -Corrosion and its prevention. -Applications.	-Definitions of terms. -Measuring potential differences. -Drawing and writing of cell diagrams. -Calculating emfs -Balancing redox equations. -Explaining notions. -Experimentation.	-Master definitions. -Observe rules for balancing redox equations. -Write and balance redox equations in aqueous and acidic media. -Draw the Daniell cell. -Draw standard electrodes and state their uses. -Measure standard electrode potentials (SEP). -Calculate cell e.m.f.s . -State and explain factors affecting S.E.P. -Use the Nernst equation to explain the effect of concentration on cell e.m.f. -Define corrosion and state some methods of prevention. -State some applications of redox reactions.	**8.2. REDOX EQUILIBRA** **8.2.1 Qualitative introduction:** By use of various examples the following concepts are to be brought out: Oxidation, reduction, redox reaction; Half reaction, oxidising agent, reducing agent. Disproportionation reaction. Oxidation numbers: Redox process and change of oxidation number. Balancing of equations by oxidation number method. Rules for balancing redox reactions through concept of electron transfer. Oxidation numbers and naming of inorganic compounds (ref. d-block). **8.2.2 Redox potentials and their measurement:** Electrode potential. The Daniell cell: Use of the Daniell cell to illustrate the p.d. of a cell and variation of this with the resistance in external circuit. Maximum p.d.= e.m.f. Use of e.m.f. values to compare relative tendencies of metal/metal ion systems to release electrons and form ions. Convention used in cell diagrams. **8.2.3 Half-cells:** The hydrogen electrode. Relative electrode potentials (use of potentiometer and valve voltmeter).Types of half-cells: metal/metal ion, non-metal/ non-metal ion, ion/ion.	-Explain: oxidation, reduction, oxidation-reduction reaction in terms of electron transfer. Oxidation number and disproportionation. -Give examples of oxidation-reduction reactions, oxidising agents, reducing agents. -Explain oxidation-reduction reactions in terms of change in oxidation number. -Balance redox equations using standard rules. -Draw diagrams of the Daniel cell and other voltaic cells. -Write conventional diagrams of voltaic cells (with electron-producing electrode on the LHS). -Calculate electromotive force (e.m.f.) of a voltaic cell. - Use e.m.f. values to compare relative tendencies of metal/metal ion systems to release electrons and form ions. -Define standard hydrogen electrode and use it to measure the standard electrode (reduction)	-Curiosity -Keen observation. -Care in handling chemicals and equipment. -Accuracy in reading instruments.	-Salt bridge. -Filter paper. -Cotton -Inert electrodes. -Platiniun/ Ni. -$AgNO_3$. -KNO_3. -KCl. - NaCl. -Porous pot. -$Na_2S_2O_3.5H_2O$. -Iodine. -H_2SO_4 . -NaOH. -NH_3 . -$CuSO_4$. -$ZnSO_4$. -Distilled water. -Chart for ECS. -Millivoltmeter. -Nails. -Grease. -Copper wire. -Zinc strip. -etc.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				8.2.4 Calculating the e.m.f. of a cell from the standard electrode potentials: Qualitative treatment of effect of concentration changes on electrode potential values. Brief discussion of the Nernst equation (No quantitative work is required). Use of Nernst equation to study concentration effects. The temperature effect to be mentioned. **8.2.5 The extended redox potentials:** use of this to calculate cell e.m.f.s and predict possible reactions in which ions are involved, non-metal/non-metal ion and ion/ion systems. Limitations of the prediction. **8.2.6** Corrosion and its prevention.	potentials of other electrode systems or half-cells. -Use of standard reduction potentials to calculate cell e.m.f.s. -Application of redox reactions in electroplating -Use standard reduction potentials to predict feasibility and direction of chemical reactions. -Explain the cause of rusting of iron and steel. -State ways of preventing rusting.		
Acid-base Equilibria	-Acids and bases. -Titrations. -Solubility of substances. -Buffer solutions. -Ionic product of water.	-Recalling. -Defining of terms. -Explaining notions. -Calculations. -Measuring. -Experimentation. -Drawing.	-Recall and master new definitions. -Compare strengths of acids and bases. -State the relationship between pH and pOH. -State and calculate equilibrium constants (Kw, Ka, Kb, Ksp). -Calculate pH values for strong and weak acidic and basic solutions. -Calculate pH and composition of buffers. -Give the importance of buffers in the human system and in agriculture. -Perform various types of titrations. -Draw and interpret	**8.3. ACID-BASE EQUILIBRIA** **8.3.1 Introduction:** leading to the Bronsted-Lowry acid-base theory. Bronsted-Lowry definition of acids and bases; conjugate acid-base pairs. Examples of Bronsted-Lowry acids and bases. Amphoteric substances. Brief discussion of Lewis acids and bases **8.3.2The ionic product of water K_w:** The K_w dependence on temperature. pH and pOH: pH < 7 = acid; pH >7 = alkaline condition. pH scale; pH measurement: The Hydrogen electrode (but pH-meter more convenient). **8.3.3 Strong and weak acids:** Compare pH values measured for weak and strong acids, Calculating pH for strong acids and bases. Dissociation constant Ka for weak acids. Calculating pH for weak acids.	-Summarise the Bronsted-Lowry theory of proton transfer of acids and bases. -Distinguish between strong and weak acids. -Give examples of: (i) acids and bases which form conjugate pairs. (ii) amphoteric substances. -Explain the terms Lewis acid and Lewis base and give an example of each. -Write an expression for the ionic product of water. -Define pH and calculate pH for strong acids and strong bases. -Write dissociation constants for weak acids (K_a) and weak bases (K_b). -Calculate the dissociation constants and pK_a values given the appropriate data. -Calculate the pH values of weak acids from pK_a values. -Explain the following: (i)	-Curiosity. -Keen observation. -Care in handling chemicals and equipment.	-pH meter. - Various acids and bases. -Indicators. -Distilled water. -sodium ethanoate. -ethanoic acid. -Common lab equipment and chemicals. -etc.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
			titration curves. -Explain how indicators function. -Choose appropriate indicators for titrations.	**8.3.4 Acid-Base Indicators:** Simple theory of indicator action; pH range of colour changes. **8.3.5 Acid-Base titrations:** with suitable examples. Strong acid- Strong base Strong acid -Weak base Weak acid - Strong base Weak acid - Weak base. **8.3.6 Buffer solutions:** (with specific examples) Definition: acid buffer, base buffer. Calculation of pH of simple buffer and of composition of buffer systems of given pH. Uses of buffer solutions. **8.3.7 Salt hydrolysis.** **8.3.8 Solubility and Solubility product:** Solubility of solute and ions; solubility of a compound. Solubility product, K_{sp}, and common ion effect on solubility. -Solubility product as an application of equilibrium law. - Other applications of solubility: predicting precipitation. Quantitative work on solubility is not required	simple theory of indicators; (ii) indicator dissociation constant; (iii) indicator range. -Sketch and interpret the four main types of acid-base titration curves. -Define a buffer solution and give examples of an acid buffer and base buffer. -Explain how buffer solutions work and give their uses. -Calculate the pH of simple buffer solutions. -Calculate the composition of a buffer of given pH. -Give examples of the acid-base reactions of salts in water. -Calculate solubilities and solubility products. -Explain and give an example of the common ion effect.		
9.0 DESCRIPTIVE INORGANIC CHEMISTRY 2: HALOGENS, GROUP IV (14), d-BLOCK ELEMENTS							
Chemistry of the elements.	-Preparation, properties and uses of halogens. -Preparation, properties and uses of halogen compounds. -Redox reactions of the	-Definitions. -Illustrations. -Predictions. -Comparative study of the chemistry of the halogens. -Preparation of halogens and halogen compounds.	-List the elements. -Write electronic configurations. -Tabulate the physical properties of the halogens. -Show graphically the variation of physical properties from F_2 to I_2. -Describe the occurrence and preparation of the elements and halides.	**9.1. HALOGENS** **9.1.1 The halogen group**, (Group VII): Group of elements: Fluorine to Iodine. A comparative study of the chemistry of chlorine, bromine and iodine. Atomic and molecular structures of the halogens. Compare the physical properties of the halogens: F_2, Cl_2, Br_2, and I_2. **9.1.2** The reactions between halides	-Describe the atomic and molecular structures of the halogens. -Compare the physical properties of the halogens. -Outline the principal chemical characteristics and trends of elements in Group VII (Group 17) of the Periodic Table. -Give specific examples of how chlorine, bromine and iodine act as oxidising agents.	-Care in handling lab equipment and chemicals. -Awareness of poisonous nature of halogens and compounds. -Carry out all reactions in a fume cupboard.	-Periodic table. -Common lab equipment. -MnO_2, HCl, $KMnO_4$, NaCl, KI, KIO_3, KBr, -Periodic Table chart. -Round and flat bottom flasks. -Delivery tubes. -Gas jars.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
	halogens and oxidation states of oxohalogen compounds.	-Reactions of halogens and halogen compounds. -Illustrate displacement and disproportionation reactions of halogens. - Experimentation	-Explain the variation in oxidation states of halogens. -Draw the oxidation number chart for the halogens. -Describe the reactions of halogens with non-metals, water, alkalis and other compounds. -Illustrate the disproportionation of chlorine and bromine in solution. -Describe displacement reactions of one halogen by another -Perform tests for halides ions. -Compare the properties of hydrogen halides and Oxo-acids of halogens. -List uses of halogens and halogen compounds. -State the effects of CFCs on the ozone layer.	and sulphuric acid, phosphoric acid and silver ions. Preparation and acidic properties of hydrogen halides, hypohalites and halates. **9.1.3 The idea of variable oxidation number.** The disproportionation action of chlorine in alkali and subsequent formation of chlorate. Identification of the oxidation states in various oxohalogen compounds (OCl^-, ClO_2^-, ClO_3^-, ClO_4^-). Redox reactions involving halogens and halides: e.g. $Br_2 + I^-$, $Cl_2 + I^-$.	-Describe and give specific examples of the reactions of chlorine, bromine and iodine with: (i) non-metals, including hydrogen, (ii) water and alkalis. -Define and give examples of disproportionation reactions of halogens (Cl_2, Br_2). -Indicate the anomalous nature of fluorine. -Compare bonding of the chlorides down Group VII (Group17) -Give examples of the most important reactions of halide ions (with silver ions, sulphuric acid, phosphoric acid). -Give an example of anomalous properties of hydrofluoric acid. -Discuss and account for the various states of halogens in their compounds. -Discuss and account for the redox reactions involving halogens and halides.	-Keenness in observations. -Accuracy in making inferences and conclusions. -Great care in handling glassware. -Put on safety goggles.	-Test tubes. -Heat source. -Fume cupboard. -$AgNO_3$. -HNO_3 acid. -NH_3 solution -conc. H_2SO_4. -conc. HCl. -Iodine -$KMnO_4$. - MnO_2. -NaCl. -KI. -KBr/ NaBr. -Distilled water. -Bromine water, -Iodine solution. -Chlorine water. -etc
Chemistry of the elements.	-Trends in structure and physical properties of the Group IV elements. -Trends in chemical reactivities of the elements on descending the Group. - Compounds of Group IV elements: Oxides,	-Definitions of terms. -Drawing of structures. -Distinguishing between allotropes. -Descriptions of reactions. -Explanations.	-List the elements -Write electronic configurations -Draw the structures of diamond and graphite. -State the unique properties of carbon. -Explain/define the terms catenation, allotropy, inert-pair effect, using suitable examples. -Outline trends in reactivity from C to Pb. -Use inert-pair effect to explain relative stabilities of compounds.	**9.2. GROUP IV(14): CARBON TO LEAD** The group of elements carbon to lead: **9.2.1 Study of trends:** Structure and physical properties of the elements of Group IV. Interpretation in terms of structure and bonding. Explain the terms allotropy, catenation and inert-pair effect and give examples of this in Group IV. Describe and give specific examples of the trends in chemical reactivity of elements on descending the Group IV; Differences and similarities should be brought out.	-Compare the structure, and chemical and physical properties of the elements in Group IV (Group 14). -Explain the terms allotropy, catenation and inert-pair effect and give examples of this from Group IV (Group 14) -Describe and give specific examples of the trend in chemical reactivity of the elements on descending Group IV (Group 14). -Explain why carbon is unique.	-Care in handling lab. equipment and chemicals. -Keenness in observations. -Awareness of importance of protecting the environment. -Awareness of hazards of CO. -Use fume cupboards when preparing	-Periodic table. -Diamond. -Graphite. -Heat source. -Lead, -Tin. -Common lab. equipment. -etc.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
	chlorides, hydrides.		-Describe the preparation and properties of hydrides, chlorides, dichlorides and oxides. -Give the uses of Group IV elements and their compounds.	**9.2.2 Compounds of Group IV elements:** Oxides, chlorides, hydrides. Oxidation states, inert pair effect, stability of the oxidation states +2 and +4 down the group. Uniqueness of carbon. Chlorides: structure, composition, hydrolytic behaviour and relative stability of chlorides. Oxides: composition, structures, acidic, basic or amphoteric nature of oxides. The hydrides: Brief, stressing the range of hydrides.	-Discuss the chemistry of the following Group IV (Group 14) compounds: (i) the oxides, (ii) the chlorides, (iii) the hydrides. -Describe the variation and stability of oxidation states down the Group: carbon to lead. -Discuss: (i) acidic-basic, and amphoteric nature of oxides, (ii) reactions of chlorides and hydrides with water for the elements carbon to lead.	poisonous gases.	
Chemistry of the elements.	-Naming, characteristics and physical properties of the first series of d-block elements; distinguishing between a d-block element and a transition element. -Variable oxidation states as in the oxides and chlorides. - Complexes. - Uses of transition metals in industrial catalysis.	- Defining terms. -Listing elements. - Writing electronic configurations. - Writing balanced chemical equations. - Preparations. - Descriptions. - Naming of complexes. - Describing isomerism in complexes. - Stating the importance of complexes. -Experimentation.	- Master simple definitions. -List elements. -Write the electronic configurations (*spdf* and electron-in-boxes) of the first transition metal series. - Distinguish between a d-block element and a transition element. -State and explain the specific characteristics of transition elements. -Give and explain the trend in some physical properties across the first transition metal series. -List and define the types of ligands in complexes. -State the types of complexes.	**9.3. d-BLOCK METALS** **9.3.1 Introduction:** Name the elements in the first series of the d-block elements and write their electronic configurations. Characteristics of a transition element making a distinction between a d-block element and a transition element. Atomic structure and electronic configuration, (*spdf* and electron-in-boxes configuration). Comparison of important physical properties of elements in the first transition metals series; melting and boiling points, heats of fusion and vaporisation. First ionisation energies and atomic radii. (Data based works and graphs). Similarities should be explained in terms of electronic structure of elements and their metallic bonding. **9.3.2 Variable oxidation states:** A review of common transition metal oxides and chlorides (Sc to Cu) bringing out the variable oxidation states and the fact that the oxidation	-Name the elements in the first series of the d-block elements and write their electronic configurations. -Describe and explain the typical physical properties of the first series of the d-block elements. -Outline the various oxidation states of the transition metals from their oxides and chlorides. -Carry out an experiment to show the variation in oxidation states of manganese, vanadium or chromium. -Discuss the stability of cations across the series scandium to copper. -Explain the following terms: paramagnetism, ligand, coordination number and chelation.	- Curiosity. - Care in handling chemicals. - keen observations. - Respect of laboratory safety rules. - Accuracy in making inferences and conclusions. - Appreciate and distinguish colours.	- Periodic Table chart - Piece of Iron. - Copper strip. - Heat source. - Electricity. - Electrical wires. - $CuSO_4$. - $FeSO_4$. - $FeCl_3$. - Murexide. - Eriochrome black. - NH_3. - EDTA. -etc.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
			- Carry out simple experiments to investigate the stoichiometry of a complex ion. - Carry out experiments to study the complex formation of iron (III) and copper (II) using different complexing agents. - Draw and name the structures of transition metal complexes. -State the various types of isomerism in complexes. - Describe the stabilities of complexes involving ligand exchange reactions. -Give importance of d-block elements and compounds.	states increase across the series until a maximum is reached, then decreases. Using the oxidation states in the oxides and chlorides of the elements Sc to Cu. Oxidation number charts should be prepared. Experimental investigation of a transition metal e.g. vanadium, Mn, Cr (experiments involving simple electro-chemical cells could be done). The energetics of formation of ions in different oxidation states, mainly in terms of ionisation energies and hydration energies, using appropriate literature data. Use E^o to predict stability of ions. Comparison of stability of cations across the series (Sc to Cu) should be made and used in interpreting disproportionation reactions. **9.3.3 Complex compounds of transition metals** The formation and stoichiometry of complex compounds (ions) -including definition of complex ion, central metal atom, a ligand, coordinate bond, coordination compounds, coordination number. (An example of a coordination compound could be used to clarify the definitions.) E.g. hexaaminocobalt (III) chloride. Naming of complexes: (IUPAC) Coordination compound: Hexaaminecobalt (III) chloride. Formula: $CoCl_3.6NH_3$ or $[Co(NH_3)_6]^{3+}\ 3Cl^-$ Complex ion: Hexaaminecobalt (III) Formula: $[Co(NH_3)_6]^{3+}$ Central atom: Cobalt Ligands: 6 ammonia molecules. Coordination number: 6 Bonding in complex ions i.e. dative covalency, types of ligands –i.e. monodentate, bidentate and polydentate ligands. Experimental study of complex	-Explain: bonding in complex ions, types of complex ions. -Describe a simple quantitative technique to investigate the stoichiometry of a complex ion. -Discuss isomerism in complex ions (limited to tetra- and hexa-coordinated systems). - Draw the structures and name the shapes of transition metal complexes. -Give examples of the importance of d-block elements and their compounds as catalysts in: (i) industries. (ii) biological systems.		

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FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				formation of copper (II) and iron (III) with a range of complexing agents leading to the characterisation of reactions as ligands-transfer reactions, giving attention to colour changes observed. The continuous variation technique as a simple quantitative investigation of stoichiometry of complex ions. Stability of complex ions: the overall stability constant of complex ions. The stepwise stability constant. From data, compare the stability constant of various complexes of some central atom. **9.3.4 Stereostructure of complex ions:** Brief discussion limited to tetra- and hexa- coordinated systems. **9.3.5 Magnetic and catalytic properties** of transition metals and their compounds: magnetic properties and examples. Catalytic behaviour of transition metals and their compounds: Brief discussion of the use of transition metals in industrial catalysis.			
10 REACTION KINETICS							
Kinetics	-Rate of reaction and factors affecting rate of reaction. - Determination of rate of reaction. -Measurement of rate of reaction. -Order of reaction.	-Definitions of terms. -Stating of factors and techniques. -Explanations of terms and notions. -Experimentation. -Measurements of quantities. -Calculating order of reaction from experimental data -	-Master definitions. -State laws. -State and explain factors that affect rate of reaction. -Plot rate curves. -State and explain factors affecting rate of reactions. -State and explain the techniques of monitoring the rates of reactions.	**10. REACTION KINETICS** **10.1. Introduction:** Include definition of rate of reaction and the why of kinetic studies. Factors which affect the rate of reactions: concentration, pressure, temperature, catalyst, surface area. **10.2. Rate determination:** Determination of rate of reaction from simple experiment: e.g. $CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(1)}$ Obtaining data and plotting a rate	-Explain the term 'chemical kinetics' and give specific examples to illustrate its importance in (i) industry, and (ii) living systems. -Explain the terms: (i) reaction rate; (ii) rate constant; (iii) order of reaction and (iv) rate expression. -Outline techniques used to measure reaction rates and give specific examples	-Care in handling chemicals. -keenness in observations. -Respect of laboratory safety rules. -Diligence in plotting and drawing graphs.	-Graph paper. -Calculators. -Stop watches. -Thermometers. -Common lab. equipments and chemicals. -Syringes. -Balloons. -Measuring cylinders. -Electronic balance (0.01g).

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
	- Theories of reaction kinetics. -Catalysis.	Drawing/sketching of graphs to show orders of reaction. -Sketching, labelling and explaining energy profiles of catalysed and uncatalysed reactions.	-Determine experimentally and graphically the order of reactions. -Suggest reaction mechanisms. -Represent the various rate orders on a curve. -Explain the theories of reaction rates. -Use Arrhenius' equation to determine activation energy. -List the types of catalysis. -Carry out specific experiments to measure the rates of some simple chemical reactions.	curve. Using the curve of reaction to obtain a value for the rate of reaction. Average rate and instantaneous rate; initial rate, units. Generalisation of variation of concentration of reactants and products with time. **10.3. Rate measurement:** Methods of measuring rate (i.e. methods used to obtain data on rates of chemical reactions). The methods should include, with appropriate examples: physical methods, chemical methods (e.g. titration), optical methods, electrochemical methods. Quantities measured to include: gas volumes, pressure, concentration, optical rotation, electrical conductivity, absorption of radiation. **10.4. Order of reaction:** From experiments and accurate measurements in homogeneous systems, do graphical presentation and interpretation of results leading to simple rate laws. Rate equation, rate constant and units. Order of a reaction, overall order. Experimental determination of order of a reaction and rate constant. Half-life of first order reactions. Zero order reaction. Interpretation of data leading to knowledge of mechanism of reaction. **10.5. Energy factor:** Gaseous systems and diffusion theory. Activation energy. Effect of temperature on reaction rate and Arrhenius equation.	of each. -List the five most important factors affecting reaction rate. -Describe and give specific examples of how each of the five factors affects the rate of reaction. -Describe briefly, an experiment to show the effect of concentration on reaction rate. -Determine reaction orders by (i) initial rates method, (ii) rate curve method, and calculate rate constants from experimental data. -Define the term 'half-life' and calculate first order half-lives from experimental data. -Explain what is meant by 'rate-determining step' and give a specific example to illustrate this. -Explain the terms: 'activation energy, 'activated complex' and 'collision frequency'. -Briefly describe how: (i) collision theory; (ii) transition state theory, can be used to explain changes in reaction rate. -Sketch and label the energy profile of a reaction and show how a catalyst affects the profile. -Distinguish between homogeneous catalysis and heterogeneous catalysis	-Accuracy in taking mass, temperature and volume measurements.	-Heat source. -Dilute HCl. -Dilute H_2SO_4. -Mg ribbon -Mg powder -$CaCO_3$ chips. -$CaCO_3$ powder -$KClO_3$. -MnO_2. -$Na_2S_2O_3$. -$KMnO_4$. -$C_2O_4^{2-}$. - etc.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				Qualitative ideas of Arrhenius equation. Use data to plot variation of rate constant with temperature. **10.6. Simple theory of Kinetics:** Brief discussion of collision theory and transition state theory. **10.7. Catalysis:** Homogeneous and heterogeneous. Enzymes in biological systems; Uses of catalysis in kinetic systems.	and give one example of each. -Give examples of enzymes as catalysts and indicate the importance of each. -Give a brief discussion of the theory of catalysis on rates of reactions.		
11.0 ORGANIC CHEMISTRY 2: STUDY OF OTHER ORGANIC COMPOUNDS: HALOALKANES, HALOBENZENES, ALCOHOLS AND PHENOLS, CARBONYLS (ALDEHDES, KETONES), CARBOXYLIC ACIDS AND ACID DERIVATIVES, NITRILES, AMINES AND AMINO ACIDS.							
Studying organic carbon compounds.	-Haloalkanes -Alcohols -Ethers -Carbonyls (aldehydes and ketones) -Carboxylic acids and derivatives. -Organic Nitrogen compounds.	-Definitions. -Nomenclature. -Classification. -Descriptions. -Identification. -Explanations. Drawing/sketching -Preparations. -Calculations. -Experimentation. -Interconversions. -Distinguishing between various compounds.	-Write the general molecular and structural formulae for each homologous series. -Master the rules for naming a particular homologous series. -Classify alcohols and halogenoalkanes into 1^o, 2^o and 3^o. -State the methods for preparing members of each homologous series. - State the various reactions of each homologous series laying emphasis on the reagents, reactions conditions and the observations made. -Give uses of members of each series. -Compare the acidity of alcohols, phenols and carboxylic acids. -Compare the basicity of nitrogen containing compounds. -Show how to	**11. Qualitative chemistry of the above series of compounds to include the following:** General methods of preparation, physical properties and chemical reactions including interconversion with other functional groups (synthetic routes). Emphasis should be made on ability to convert one functional group to another and provide links in a synthetic chain. Characterisation tests and/or distinguishing tests. **11.1. Halogenoalkanes and Halogenobenzenes:** **11.2. Alcohols:** Primary, secondary and tertiary class alcohols. Oxidation. ** **11.3. Aldehydes and ketones:** Mechanism of nucleophilic addition observed in this section should be discussed. Include brief discussion of reducing sugars and carbohydrates. **11.4. Acids and acid derivatives:** **11.5. Organic nitrogen compounds:** **11.5.1 Nitro-compounds:** aliphatic and aromatic.	-Write the names and structural formulae of typical examples of compounds in each of the following series: haloalkanes, halobenzenes, alcohols and phenols, aldehydes, ketones, carboxylic acids, esters, acid chlorides, acid anhydrides, amides, nitriles, amines and amino acids. -Describe the typical physical properties of the compounds above. -Describe simple laboratory methods of preparing the compounds above. -Give examples of the important chemical properties of the compounds above. -List important uses of the compounds above. -Give equations, reagents and reaction conditions to convert one class to	Curiosity. -Observe laboratory safety rules. -Diligence in balancing equations. -Accuracy in making inferences and drawing conclusions.	-Molecular models. -charts. -Heat source. -laboratory equipment. -Methanol. -Ethanol. -Cyclohexene. -Propan-1-ol. -Propan-2-ol. -Ethanal. -Propanone. -Phenol. -Ethanoic acid. -Ethanamide. -Aniline. -Glycine. -Glucose. -Sucrose. -Starch. 2-Naphthol. -$NaNO_2/KNO_2$ -$AgNO_3$ -HCl acid -H_2SO_4 acid -$KMnO_4$ -NH_3. -2,4-DNPH.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
			i) Ascend a homologous series. e.g. The use of the cyanide ions. ii) Descend a homologous series e.g. Hoffman degradation. -Name and draw structures of amino acids. -Explain the term essential amino acids, zwitterion and isoelectronic points. -Give the methods of separating amino acids. -Draw structures to show the formation of a peptide link (bond). -Give a brief account of polymerisation (addition and condensation). - Do interconversion of functional groups (synthetic routes): Emphasis on ability to convert one functional group to another and provide links in a synthetic chain, laying emphasis on the reagents, reactions conditions and the observations made.	**11.5.2 Nitriles:** formation from halides and from amides; chemical reactions. **11.5.3 Amides:** formation from carboxylic acids and other derivatives; chemical reactions. **11.5.4 Amines:** Formation of primary amines from nitro-compounds, nitriles and amides. Formation of primary, secondary and tertiary amines and quaternary compounds by alkylation. Basicity: Comparison of basicities of ammonia, aliphatic primary and secondary amines, aromatic primary amines and amides. Reactions of primary amines with nitrous acid. Diazo-coupling with naphthalene-2-ol (2-naphthol). Acylation: Acetylation and benzylation of aniline. Use of derivatives for characterisation. **11.5.5 Amino acids:** Acid/base character; Buffer action. Simple treatment of polypeptides.	another of the compounds above. -Show how it is possible for the compounds above to: i) ascend the homologous series in certain groups. e.g. ethanoic acid to propanoic acid. (ii) descend the homologous series in certain groups. e.g. ethanol to methanol. -Give the names and draw the structures of simple amino acids. -Explain the terms: essential amino acids, zwitterion, and isoelectronic point. -Outline how amino acids may be separated and detected. -Draw a peptide link and give an example of a polypeptide. -Write brief accounts on: (i) addition polymerisation. (ii) condensation polymerisation.		-PCl_5. -Bromine water. -other Organic reagents -etc.
12.0 ORGANIC CHEMISTRY 3: REACTION MECHANISMS AND SYNTHETIC ROUTES							
Studying organic carbon compounds.	-Electrophilic, nucleophilic and free-radical substitution reactions. -Electrophilic,	Writing of reaction mechanisms using halved and doubled headed arrows to show movements of	- Define reaction mechanism. -State the various types of organic reaction mechanisms and let the students know that a reaction type depends on	**12.1. Reaction mechanisms in organic chemistry:** **12.1.1 Substitution reactions:** - Free-radical Substitution. - Nucleophilic substitutions: (SN_1 & SN_2). -Electrophilic substitution.	-Define reaction mechanism. -Know how free radicals and ions are generated. -State the various types of organic reactions based on the attacking group and the	Curiosity	-Charts of various reactions mechanisms illustrated. -Video support.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
	nucleophilic and free-radical addition reactions.	electrons.	the attacking group and the final product obtained. -State the use of a half arrow and doubled arrow in reaction mechanisms. -Using suitable examples in each case to show the mechanisms involved in the various types of organic reactions.	**12.1.2 Addition reactions:** -Elelctrophilic addition. -Nucleophilic addition. **12.1.3 Elimination reactions:** -Dehydration. -Dehydrogenation. -Dehydrohalogenation. **12.1.4 Polymerisation;** types of polymers and mechanism of formation. **12.2. Synthetic Routes:**	final product obtained. -Know when to use halved arrows and doubled arrows in reaction mechanisms. -Write out the mechanisms involved in the various types of organic reactions, using suitable examples. -Explain why a particular reaction mechanism is undergone by a specific class of organic compounds.		
13.0 CHEMISTRY AND SOCIETY: ALUMINIUM, NITROGEN AND SULPHUR.							
Chemistry and Society.	- Extraction of Aluminium. - Oxidation states of sulphur and nitrogen. - Industrial manufacture of sulphuric acid. - Industrial manufacture of Ammonia. - Fertilizers and pollution.	- Descriptions of some industrial processes. -Identifying some processes and their products. - Explaining some chemical properties of Aluminium, sulphur, nitrogen and their compounds. - Identifying some fertilizers. - Stating the effects of fertilizers on the environment. - Stating some uses of sulphur, nitrogen and their compounds. - Experimentation.	- Describe the extraction of Aluminium. - Describe the industrial preparation of sulphuric acid and ammonia and state their uses. - Identify some nitrogenous and non-nitrogenous fertilizers. - State some environmental problems related to the use of fertilizers. - Carry out simple experiments to investigate the reactions of nitric acid with Cu, H_2S, I^-, Fe^{2+}.	**13.1. Aluminium:** Brief discussion of aluminium as a member of Group III. Extraction from ore, chemical properties and uses of aluminium. **13.2. Sulphur:** The range of oxidation states shown by sulphur, using specific species to show this; the principal oxidation states of sulphur being: -2, +2, +4, +6. The Contact process for the manufacture of sulphuric acid and the importance of sulphur compounds. Physical and chemical principles in the Contact process. Redox reactions involving sulphur. Construction of oxidation number chart. Reactions of H_2S and H_2SO_4 with $KMnO_4$, and with solid halides. Reactions of halides with concentrated sulphuric acid. The disproportionation of thiosulphate in acid solution. Quantitative study of reaction of thiosulphate and iodine; and sulphite with iodine in aqueous	-Summarise the principal chemistry of: (i) aluminium (ii) aluminium oxide (iii) aluminium halides (iv) aluminium sulphate and alums. -Outline the occurrence and extraction of aluminium. -List important uses of aluminium, its alloys and its compounds. -Write the electronic configurations of sulphur and nitrogen. -Give the compounds of sulphur and nitrogen with different oxidation states. -Describe redox reactions involving: (i) sulphur and its compounds. (ii) nitrogen and its compounds. -Outline the industrial production of:	- Awareness of some nitrogenous products in agriculture. -Keen observations.	- Periodic Table chart. - Aluminium. - Air. - Sulphur. - Aluminium utensils. - Nitrogenous fertilizer. - Sulphuric acid. - $KMnO_4$. - FeS. - $Na_2S_2O_3$. - water. - Copper. - KI - Non-nitrogenous fertilizers. - Charts of the Contact and Haber processes. - Rotten eggs.

CONTEXTUAL FRAMEWORK		COMPETENCIES		RESOURCES			
FAMILIES OF SITUATIONS	**EXAMPLES OF SITUATIONS**	**CATEGORIES OF ACTIONS**	**EXAMPLES OF ACTIONS**	**CONTENT (CORE KNOWLEDGE)**	**APTITUDES (SKILLS)**	**ATTITUDES**	**OTHER RESOURCES**
				solution. **13.3. Nitrogen:** The range of nitrogen compounds in different oxidation states. Construction of an oxidation number chart for the range of nitrogen compounds; the principal oxidation states ranging from -3 to +5. Redox reactions involving nitrogen compounds. Oxidising properties of nitric acid under varying conditions of pH. Practical investigations of the reactions of nitric acid and Cu, H_2S, I^-, Fe^{2+}. The Haber process for the manufacture of ammonia. Nitrogen compounds in nutrition, agriculture and industry: nitrogenous and non-nitrogenous fertilizers. Fertilizers and pollution.	(i) ammonia. (ii) sulphuric acid. Discuss the uses of: (i) sulphuric acid and its compounds, (ii) ammonia. -Discuss the pollution caused by nitrogen oxides and by sulphur oxides. -Discuss the importance of nitrogen compounds in nutrition, agriculture and industry. Give examples of nitrogenous and non-nitrogenous fertilizers and state environmental problems related to the use of fertilizers.		- Nitric acid. - etc.

PRACTICALS

1. TIME ALLOCATION: 108 (54 + 54) PERIODS (90 HOURS)

2. GENERAL PRESENTATION:

Practicals are spread evenly over the two-year course and are expected to begin early in the first term in LSS and go on weekly through the course up to the third term in USS. Practical work is divided into three parts: Quantitative Analysis, Qualitative Analysis and School Project and/or Field Trip to an industrial site. Each student will need a laboratory exercise book, file or manual that will contain all the exercises he/she is supposed to carry out during the two years.

A - Quantitative Analysis: The student is expected to carry out a minimum of three exercises in each of the following:

a) Acid-base titrations.
b) Redox titrations.
c) Precipitation titrations (one only).
d) Complexometric titrations (one only).
e) Thermochemistry / Energetics.
f) Rates of reactions / Kinetics.

B - Qualitative Analysis: The student is expected to carry out a minimum of five practical sessions in each of the following:

a) Qualitative inorganic reactions.
b) Qualitative organic reactions.

C - School Project and Field Trip to an industrial site: Teacher to choose and realise at least one simple specified school project and one field trip to an industrial site, which should be realised by the end of USS and documented.

POSSIBLE PROJECTS THAT STUDENTS CAN REALISE AFTER GOING THROUGH THE LSS AND USS CHEMISTRY PROGRAM

- ✓ Preparation and analysis of Aspirin.
- ✓ Effect of acid rain on limestone.
- ✓ Manufacture of soaps.
- ✓ Manufacture of detergents.
- ✓ Production of body lotions.
- ✓ Fermentation to obtain alcohols, yoghurt using carbohydrates from different foodstuffs and fruits.
- ✓ Distillation and purity control of local drinks.
- ✓ Production of starch from cassava.
- ✓ Effect of Thermal treatment on the physical and chemical properties of recycled polypropylene.
- ✓ Extraction of local medicinal/natural products (e.g. caffeine, fruit juice, perfumes etc.).
- ✓ Purification and treatment of water for domestic use.
- ✓ Production of dyes and the dyeing of fabrics.

This list is, however, not exhaustive and teachers can update it with short realisable projects.

Article 2: The curricula referred to in Article 1 above, shall be implemented as from the beginning of the 2019-2020 school year.

Article 3: Any previous provisions contrary to the terms of this Order are thus repealed.

Article 4 : The Inspector General of Education, the Inspector Coordinators General, the Director of the Office du Baccalauréat du Cameroun, the Registrar of the Cameroon GCE Board, Regional and Divisional Delegates of Secondary Education, the Secretaries of Education for the various Private Education orders and Heads of Government and Private Schools are each responsible for the strict implementation of this Order, which will be registered, published in the Official Gazette in French and English and communicated wherever necessary.

Done in Yaounde, on 24 JAN 2020

THE MINISTER OF SECONDARY EDUCATION

REPUBLIQUE DU CAMEROUN
REPUBLIC OF CAMEROON
Paix - Travail - Patrie
Peace - Work - Fatherland
Le Ministre
The Minister
MINISTRY OF SECONDARY EDUCATION
MINISTERE DES ENSEIGNEMENTS SECONDAIRES

Nalova Lyonga, Ph.D.

CC:
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-CAB/MINESEC
-SEESEN
-IGE
-ICG(s)
-DAJ
-DESG
-DESTP
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-REGISTRAR GCE BOARD
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