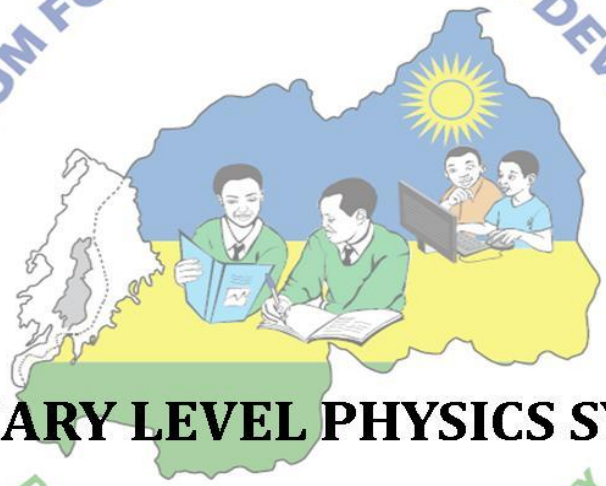
REPUBLIC OF RWANDA

MINISTRY OF EDUCATION

Rwanda Education Board

CURRICULUM FOR SUSTAINABLE DEVELOPMENT



DIGNITY AND NATIONAL IDENTITY

ORDINARY LEVEL PHYSICS SYLLABUS

Kigali, 2015

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FOREWORD

The Rwanda Education Board is honoured to provide syllabuses which serve as both official documents and as a guide to competence-based teaching and learning. These syllabuses ensure consistency and coherence in the delivery of quality education across all levels of general education in Rwandan schools. The Rwandan education philosophy aims to ensure that young people at every level of education achieve their full potential in terms of relevant knowledge, skills and appropriate attitudes in order to prepare them to be well integrated into society and exploit employment opportunities.

In line with efforts to improve the quality of education, the government of Rwanda emphasises the importance of aligning the syllabus, teaching and learning and assessment approaches in order to ensure that the system is producing the kind of citizens the country needs. Many factors influence what children are taught, how well they learn and the competences they acquire, particularly the relevance of the syllabus, the quality of teachers' pedagogical approaches, the assessment strategies and the instructional materials available. The ambition to develop a knowledge-based society and the growth of regional and global competition in the jobs market has necessitated the shift to a competence-based syllabus. With the help of the teachers, whose role is central to the success of the syllabus, learners will gain appropriate skills and be able to apply what they have learned in real life situations. Hence they will make a difference not only to their own lives but also to the success of the nation.

I wish to sincerely extend my appreciation to the people who contributed to the development of this document, particularly the REB and its staff who organized the whole process from its inception. Special appreciation goes to the development partners who supported the exercise throughout. Any comment or contribution would be welcome to the improvement of this syllabus.

GASANA I. Janvier
Director General REB

ACKNOWLEDGEMENT

I wish to sincerely extend my special appreciation to the people who played a major role in the development of this syllabus. It would not have been successful without the participation of a range of education stakeholders and the financial support from different donors. For this, I would like to express my deep gratitude.

My thanks first go to the Rwanda Education Board staffs who were involved in the conception and writing of the syllabus. I wish to extend my appreciation to teachers from pre-primary to university level, for their valuable efforts during conception of the syllabus.

I owe gratitude to the different education partners such as UNICEF, UNFPA, DFID and Access to Finance Rwanda for their financial and technical support.

We also value the contribution of other education partner organisations such as CNLG, AEGIS trust, Itorero ry'Igihugu, Center for Gender Studies, Gender Monitoring Office, National Unit and Reconciliation Commission, RBS, REMA, Handicap International, Wellspring Foundation, Right To Play, MEDISAR, EDC/L3, EDC/Akazi Kanoze, Save the Children, Faith Based Organisations, WDA, MINECOFIN and Local and International consultants. Their respective initiatives, co- operation and support were significantly contributed to the successful production of this syllabus by the Curriculum and Pedagogical Material Production Department (CPMD).

Dr. MUSABE Joyce
Head of CPMD

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TABLE OF CONTENTS

1. INTRODUCTION

1.1. Background to curriculum review

The rationale behind the Physics syllabus review process is to ensure that the syllabus is responsive to the needs of the learner and to shift from objective and knowledge based learning to competence based learning. Emphasis in the review has been on building skills and competences, as well as streamlining the coherence of the existing content by benchmarking against a number of best practice syllabi.
The new Physics syllabus guides the interaction between the teacher and the learner in the learning processes and highlights the essential practical skills and competences a learner should acquire, during and at the end of each learning unit.

1.2. Rationale of teaching and learning physics

1.2.1. Physics and society

Physics is one of the natural science subjects and contributes significantly to global socioeconomic transformation through its discoveries. These have led to development of new technologies in all fields of production and are beneficial to mankind. Applications of Physics knowledge is evident in industries such as engineering, transport (automobiles, trains, planes, etc.), medicine and Information and Communication Technology (ICT).

Physics significantly contributes to the advancement of new technologies that arise from theoretical breakthroughs. For example, advances and understanding of electromagnetism or nuclear physics has led to the development of new products, which have dramatically transformed the

modern society. Some of the discoveries based on Physics knowledge include televisions, computers, electrical appliances, and nuclear weapons advancements in thermodynamics and mechanics, which led to industrialization

Physics is key to the Rwandan education ambition of developing a knowledge-based society. It promotes science and technology which are necessary for learners to be competitive in both regional and global job markets. This new curriculum will address gaps in appropriate skills and attitudes provided by the current Rwandan Education system.

1.2.2 Physics and learners

Physics is a worthwhile subject because it prepares students for the real world of work by providing career pathways in mechanical engineering, construction engineering, information and communication technology and other related fields. Physics provides skills that guide in the construction of theories and laws that help to explain natural phenomenon and enable management of the environment.

It also provides answers to problems faced in our modern society by empowering students to be creative and innovative leading to independent approaches of solving daily life problems. Through physics students explore the laws and rules that govern all natural phenomena observed in the universe.

1.2.3 Competences

A competence is defined as the ability to use an appropriate combination of knowledge, skills, attitudes, values and behaviours to accomplish a particular task successfully. That is the ability to apply learning with confidence in a range of situations.

Basic competences are addressed in the stated broad subject competences and in the objectives highlighted in a year on year basis and in each of the units of learning. The generic competences and broad subject competences that must be emphasized and reflected in the learning process are briefly described below and teachers will ensure that learners are exposed to tasks that help the learners acquire the skills.

Generic competences

Critical thinking and problem solving skills: The acquisition of such skills will help learners to think imaginatively, innovatively and broadly to evaluate and find solutions to problems encountered in our surroundings.

Creativity and innovation: The acquisition of such skills will help learners to take initiatives and use imagination beyond the knowledge provided in the classroom, to generate new ideas and construct new concepts.

Research: This will help learners to find answers to questions based on existing information and concepts and use it explain phenomena from gathered information.

Communication in official languages: Teachers, irrespective of being language teachers will ensure the proper use of the language of instruction by learners. The teachers should communicate clearly and confidently and convey ideas effectively through spoken and written word, applying appropriate language and relevant vocabulary.

Cooperation, inter personal management and life skills: This will help the learner to cooperate as a team in whatever task is assigned and to practice positive ethical moral values, while respecting the rights, feelings and views of others. Perform practical activities related to environmental conservation and protection. Advocate for personal, family and community health, hygiene and nutrition by responding creatively to a variety of challenges encountered in life.

Lifelong learning: The acquisition of such skills will help learners to update knowledge and skills with minimum external support. The learners will be able to cope with evolution of knowledge advances for personal fulfilment in areas that are relevant to their improvement and development.

Broad physics competences

During and at the end of learning process, the learner can:

- Analyze and explain physics phenomena relating to life experience;
- Use and experiment with a range of scientific and technological tools and equipment and draw appropriate conclusions;
- Demonstrate curiosity, research skills and creativity;
- Apply scientific inquiry and methods to investigations;
- Apply knowledge of mathematics and technology to scientific investigation;
- Observe, analyse, evaluate and interpret without prejudice and make reasonable decisions;
- Use principles of scientific methods and experimental techniques to solve specific problems in life;
- Develop attitudes in which scientific investigation depends on honesty, persistence, critical thinking and tolerance of uncertainty;
- Appreciate the scientific, social, economic, environmental and technological implications of physics;
- Identify legal and ethical requirements for proper use, care, handling and disposal of organisms and chemicals into the environment;
- Identify safe and appropriate techniques used in the preparation, storage, dispensing and supervision of materials used in science instructions;
- Identify national legal requirements and standards for safe preparation, use, storage, and disposal of the materials used.

Physics and developing competences

The policy documents based on national aspirations identify some 'Basic Competences' alongside the 'Generic Competences'' that will develop higher order thinking skills and help students to learn subject content and promote application of acquired knowledge and skills.

Through observation, experimentation, and presentation of information during the learning process, the learner will not only develop deductive and inductive skills, but also acquire cooperation, communication, critical thinking and problem solving skills. This will be realized when learners make presentations leading to inferences and conclusions at the end of learning unit. This will be achieved through learner group work and cooperative learning of physics, which in turn will promote interpersonal relations and teamwork.

The manipulation of apparatus and data during class experiments and the undertaking of project work by learners will involve analytical and problem solving skills directed towards innovation, creativity and research activities by the learners.

The acquired knowledge from learning physics should help develop a responsible citizen who uses scientific reasoning and attitudes to develop confidence in reasoning independently. The learner should show concern for individual attitudes, environmental protection and comply with the scientific method of reasoning. The scientific method should be applied with the necessary rigor and intellectual honesty to promote critical thinking while systematically pursuing the line of thought.

2. PEDAGOGICAL APPROACH

Learners enjoy learning when they are actively involved in the learning process with a high degree of participation, contribution and presentation. At the same time, each learner is an individual with their own needs, pace of learning, experiences and abilities. Teaching strategies must therefore be varied and flexible within well-structured sequences of lessons. Learner-centered education does not mean that the teacher is no longer responsible for learner learning.

2.1 Role of the learner

The activities to engage the learner are indicated against each learning unit and reflect appropriate engagement of the learner in the learning process. The teaching/ learning process activities are tailored towards creating a learner friendly environment based on the abilities, needs, experiences and interests of the learner.

The learning activities are organized in such a way that they encourage learners to construct their own knowledge (minds-on and hands-on activities) either individually or in groups. The learner should suggest how to solve challenging problems exposed to them. Learners should work on

one competence outcome at a time in the form of a concrete unit with specific learning objectives, which are broken into knowledge, skills and attitudes.

In practical lessons, learners will work in groups depending on the availability of the apparatus, however if apparatus numbers permit, then they work individually. Working on simple project work individually will be encouraged and emphasized. Learners should use textbooks and other resources for complementing the knowledge acquired in classroom. Learners should strive to become thinkers, inquirers, problem solvers, and communicators. Learners should be principled, open-minded, caring, risk takers, balanced in reflection.

2.2. Role of the teacher

The change to a competence-based curriculum is about transforming learning by ensuring that learning is deep, enjoyable and habit-forming.

Teachers must shift from the traditional method of instruction to become facilitators in order to value and understand the learner's individual needs and expectations. The teacher must identify the needs of the learners, the nature of the learning to be undertaken, and the means to shape learning experiences accordingly.

The teacher's role is to organize the learners in or outside the classroom, engaging them through participatory and interactive methods. Learning processes should target individual learners, pairs of learners or large of groups. This organization ensures that learning is personalized, active, participatory and co-operative in nature. The teacher should design and introduce tasks for the entire class to perform or for immediate discussion. The role of the teacher should be to guide the learners in constructing their own knowledge.

Learners should be taught how to use the textbooks and other resource materials as supplementary ways of acquiring knowledge. During research learners should take summary notes of what they are reading. The teacher must select and develop appropriate teaching materials like models, charts, and ICT facilities such as the internet, videos, computers, simulations and so on.

During practical lessons, the teacher should first demonstrate the experiment procedure and manipulation of the apparatus. For dangerous tasks teachers should give a demonstration of the experiment before exposing it to the learners.
The teacher must devise remedial strategies in and outside the classroom to cater for low achievers and those with learning difficulties, in order to ensure they keep pace with other learners in acquiring the required competences.

2.3 Special needs education and inclusive approach

All Rwandans have the right to access education regardless of their different needs. The underpinnings of this provision would naturally hold that all citizens benefit from the same menu of educational programs. The possibility of this assumption is the focus of special needs education. The critical issue is that we have persons/ learners who are totally different in their ways of living and learning, as opposed to the majority. These differences can either be emotional, physical or sensory. Traditionally intellectual learning challenges were traditionally known as mental retardation.
These learners equally have the right to benefit from the free and compulsory basic education in nearby ordinary/mainstream schools. Therefore, the schools obligation is to enrol them and also set strategies to provide relevant education to them. The teacher therefore is requested to consider each learner's needs during teaching and learning process. Assessment strategies and conditions should also be standardised to the needs of these learners. Detailed information for each category of learners with special education needs is provided in the guidance for teacher's section.

3. ASSESSMENT APPROACH

Assessment is the process of evaluating teaching and learning processes, by collecting and interpreting evidence of an individual learner's progress and to make a judgment about a learner's achievements measured against defined standards. Assessment is an integral part of the teaching learning

process. In the new competence-based curriculum, assessment must also be competence-based, where a learner is given a complex situation related to their everyday life and asked to try to overcome the situation by applying what they have learned.
Assessment will be organized at the following levels: School-based assessment, District examinations, National assessment (LARS) and National examinations.

3.1. Types of assessment

3.1.1 Formative and continuous assessment. (Assessment for learning)

Continuous assessment involves formal and informal methods used by schools to check whether learning is taking place. When a teacher is planning their lesson, they should establish criteria for performance and behaviour changes at the beginning of a unit. At the of end of every unit, the teacher should ensure that all the learners have mastered the stated key unit competences based on the criteria stated, before going to the next unit. The teacher will assess how well each learner masters both the subject and the generic competences described in the syllabus. From this, the teacher will gain a picture of the overall progress of the learner. The teacher will use one or a combination of the following; (a) observation (b) pen and paper (c) oral questioning and d) experimentation. A change of behaviour (values, attitudes, beliefs and obeying of norms) is the major indicator ensuring that teaching and learning has taken place. Therefore the set of mastery criterion should also reflect the change in behaviour of the learner.

3.1.2 Summative assessment. (Assessment of learning)

When assessment is used to record a judgment of a competence or performance of the learner, it serves a summative purpose. Summative assessment gives a picture of a learner's competence or progress at any specific moment. The main purpose of summative assessment is to evaluate

whether learning objectives have been achieved and to use the results for the ranking or grading of learners. The assessment is used for deciding on progression, for selection into the next level of education and for certification. This assessment should have an integrative aspect whereby a student must be able to show mastery of all competences.

It can be an internal school based assessment or external assessment in the form of national examinations. School based summative assessment should take place once at the end of each term and once at the end of the year. School summative assessment average scores for each subject will be weighted and included in the final national examinations grade. School based assessment average grade will contribute a certain percentage as teachers gain more experience and confidence in assessment techniques. In the third year of the implementation of the new curriculum it will contribute 10% of the final grade, but will be progressively increased. Districts will be supported to continue their initiative to organize a common test per class for all the schools to evaluate the performance and the achievement level of learners in individual schools. External summative assessment will be done at the end of S3 and S6.

3.2 Record keeping

Record keeping is the gathering facts and evidence from assessment instruments and using them to judge the student's performance by assigning an indicator against the set criteria or standard. Whatever assessment procedures used shall generate data in the form of scores, which will be carefully recorded and stored in a portfolio. The scores will contribute to remedial actions, alternative instructional strategies, feed back to the learner, for parents to check the learning progress and for teachers to advise accordingly, as well as to the final assessment of the students.

This portfolio is a folder (or binder or even a digital collection) containing the student's work, as well as the student's evaluation of the strengths and weaknesses of the work. Portfolios reflect not only work produced (such as papers and assignments), but also it is a record of the activities undertaken over time as part of student learning including the worksheets. The portfolio output (formative assessment) will be considered only as

enough for three years of a level. It will serve as a verification tool for each learner that they attended the whole learning before they undergo the summative assessment for the subject. The results from the portfolio will contribute 50% of summative assessment of each year.

3.3. Item writing in summative assessment

Before developing a question paper, a plan, or specification of what is to be tested or examined, it must be elaborated to show the units or topics to be tested on, the number of questions in each level of Bloom's taxonomy and the marks allocation for each question. In a competence based curriculum, questions from higher levels of Bloom's taxonomy should be given more weight than those from knowledge and comprehension levels.

Before developing a question paper, the item writer must ensure that the test or examination questions are tailored towards competence based assessment by doing the following:

- Identify topic areas to be tested from the subject syllabus.
- Outline subject matter content to be considered as the basis for the test.
- Identify learning outcomes to be measured by the test.
- Prepare a table of specifications.
- Ensure that the verbs used in the formulation of questions do not require memorization or recall answers only, but test broad competences as stated in the syllabus.

Structure and format of the examination

There will be two papers for Physics subject at ordinary level. Paper 1 consists of closed, semi-structured and open/ extended questions while paper 2 is practical. Time will depend on the paper's items and weight. Extra time will be given to learners with special education needs if found necessary.

Paper	Component	Weight
Paper 1	The paper will measure both knowledge and understanding of the subject matter and acquisition of competences. The question items will be balanced as follows: • Assessment of Knowledge and understanding (questions from low levels of Bloom's taxonomy) 30 % • Assessment of Skills and competences (questions from higher levels of Bloom's taxonomy :application, analysis, evaluation and synthesis) 40%	70%
Paper 2	Practical skills: The paper to measure practical/experimental skills (Observation, Recording & report writing, Manipulation, Measurement, Planning & designing) The experiments should be drawn from different topic areas of the syllabus.	30%

Assessment of Subject objectives (AO)

The assessment objectives listed below reflect those parts of the syllabus competences that will be assessed in the examination.

- **AO1 Knowledge with understanding**

Candidates should be able to demonstrate knowledge and understanding of:

- Scientific phenomena, facts, laws, definitions, concepts and theories.
- Scientific vocabulary, terminology and conventions. (Including symbols, quantities and units)
- Scientific instruments and apparatus used in Physics, including techniques of operation and aspects of safety.
- Scientific quantities and their determination.
- Scientific and technological applications, with their social, economic and environmental implications.

The subject content defines the factual knowledge that candidates may be required to recall and explain.

Questions testing these assessment objectives will often begin with one of the following words: define, state, name, describe, explain (using your knowledge and understanding) or outline.

- **AO2 Handling information and solving problems**

Candidates should be able to handle information and solve problems, using, written, symbolic, graphical and numerical forms of presentation to:

- Locate, select, organize and present information from a variety of sources.
- Translate information from one form to another.
- Manipulate numerical and other data.
- Use information to identify patterns, report trends and draw conclusions.
- Give reasoned explanations for phenomena, patterns and relationships.
- Make predictions and hypotheses.
- Apply knowledge including principles to new situations.
- Demonstrate an awareness of the limitations of physics theories and models.
- Solve problems.

These assessment objectives cannot be precisely specified in the syllabus content because questions testing such skills may be based on information which is unfamiliar to the candidate. In answering such questions, candidates are required to use principles and concepts that are within the syllabus and apply them in a logical, reasoned or deductive manner to a new situation.
Questions testing these assessment objectives will often begin with one of the following words: discuss, predict, suggest, calculate, and explain (give reasoned explanations and explain the processes of using information and solving problems) or determine.

- **AO3 Experimental skills and investigations**

Candidates should be able to:

- Observe, give feedback, plan experiments and investigations.
- Collect, record and present observations, measurements and estimates.
- Analyse and interpret data to reach conclusions.
- Evaluate methods and quality of data and suggest possible improvements.
- Use ICT in solving problems.

3.4 Reporting to parents

The wider range of learning in the new curriculum means that it is necessary to think again about how to share a learners' progress with their parents. A single mark is not sufficient to convey the different expectations of learning that are outlined in the learning objectives. The most helpful reporting is to share what students are doing well and where they need to improve.

4. RESOURCES

4.1 Material resources

Teaching and learning of Physics entails practical activities for better conceptualisation of concepts and facts. The successful implementation of this curriculum requires Physics laboratories, textbooks, charts and ICT tools like computers and projectors.

There are some Physics concepts that cannot be easily explained and some experiments that cannot be done in our school laboratories due to safety reasons. The use of ICT in teaching and learning is vital. With ICT, these concepts can be visualised by use of animations and simulations. Similarly both teachers and learners are encouraged to use the Internet for research as well as other ICT tools, for teaching and learning purposes.

4.2 Human resources

The effective implementation of this curriculum needs the joint collaboration of educators at all levels. Given the material requirements, teachers are expected to accomplish their noble role as stated above. School head teachers and directors of studies are required to follow-up and assess the teaching and learning of this subject due to their profile in the schools. These combined efforts will ensure bright future careers and lives for learners as well as the contemporary development of the country.

The following are some of the skills required for the teacher:

- Engage students in variety of learning activities.
- Use multiple teaching and assessment methods.
- Adjust instructions to the level of the learner.
- Creativity and innovation.
- Makes connections/relations with other subjects.
- Should have a high level of knowledge of the content.
- Effective discipline skills.

- Good classroom management skills.
- Good communicator.
- Guide and counsellor.
- Passion for teaching children and learning.

5. SYLLABUS UNITS

5.1 Presentation of the Structure of the syllabus units

PHYSICS subject is taught and learned in lower secondary education as a core subject, i.e. in S1, S2 and S3 respectively. At every grade, the syllabus is structured in Topic Areas, Sub-topic Areas where applicable and then further broken down into Units. The Units have the following elements:

- Unit is aligned with the Number of Lessons.
- Each Unit has a Key Unit Competence whose achievement is pursued by all teaching and learning activities undertaken by both the teacher and the learners.
- Each Unit Key Competence is broken into three types of Learning Objectives as follows:
- Type I: Learning Objectives relating to Knowledge and Understanding (Type I Learning Objectives are also known as Lower Order Thinking Skills or LOTS)
- Type II and Type III: These Learning Objectives relate to acquisition of Skills, Attitudes and Values (Type II and Type III Learning Objectives are also known as Higher Order Thinking Skills or HOTS) – These Learning Objectives are actually considered to be the ones targeted by the present reviewed curriculum.
- Each Unit has content which indicates the scope of coverage of what a teacher should teach and learner should learn, in line with stated learning objectives.
- Each Unit suggests Learning Activities that are expected to engage learners in an interactive learning process as much as possible. (Learner-centered and participatory approach).
- Finally, each Unit is linked to Other Subjects, its Assessment Criteria and the Materials (or Resources) are expected to be used in the teaching and learning process.

In all, the syllabus of PHYSICS for ordinary level has eight Topic Areas (Physical quantities, Mechanics, Heat, Thermodynamics, Electricity, Light, Electronics, and Environmental Physics). There are 13 Units in S1, 15 Units in S2 and 15 Units in S3.

5.2 Senior One

5.2.1 Key competences for senior one

- Appreciate scientific, social, economic, environmental and technological implications of Physics.
- Use appropriate laboratory equipment and materials to carry out experiments.
- Identify potentially hazardous situations in a physics laboratory and classroom and methods of prevention.
- Apply the concepts of accuracy, precision, uncertainty and significant figures to measurements and calculations.
- Identify prefixes in the metric system and standard units of measure.
- Newton, Metre, Kilowatt-hours, Tesla, Electron volts, Calories.
- Explain types of forces.
- Determine experimentally the position of centre of gravity of a body.
- Explain physical properties of solids, liquids and gases.
- Differentiate magnetic and non-magnetic materials.
- Explain the effects of electricity and its precautions in everyday life.
- Explain the nature of light and its physical propagation.
- Analyse the phenomena of refraction and reflection of light.
- Explain the properties of semiconductor materials.

5.2.2 Senior one Units

TOPIC AREA: MECHANICS	SUB-TOPIC: INTRODUCTION TO PHYSICS	
S1 PHYSICS	**Unit 1:** Laboratory safety rules and measurements of physical quantities	**Nº of periods: 15**

Key unit competence: By the end of this unit the learner should be able to explain the importance of physics, measure physical quantities and express findings in appropriate units.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain the nature of Physics and its application. – Characteristics of physics. – Discuss branches of physics and their benefits to mankind's development. – Identify career opportunities related to Physics. – Explain the basic fundamental physical quantities. – Differentiate between derived physical quantities and fundamental	– Explain the relationship between physics technology and society. – Formulate scientific predictions. – State and explain basic laboratory rules for conducting experiments. – Write a simple scientific report of experiment carried out. – Identify laboratory hazards and safety precautions to be taken. – Choose a appropriate	– Appreciate application of physics in everyday life situations. – Develop responsible behaviour towards environmental problems. – Apply scientific method with all the rigor, intellectual honesty and critical thinking. – Comply with laboratory safety rules. – Behave as responsible citizens that are able to make decisions based on scientific attitudes and findings. – Use of appropriate terminologies and simple	– Physics as science subject. – Definition of Physics and its relationship to other sciences subjects society and technology. – Science processes skills used in learning of physics (observation, prediction, data reading and recording, data analysis, interpretation, decision making and reporting). – Laboratory safety and safety rules. – Definition of basic fundamental quantities (mass, length and time). – Measuring instruments used in measuring length, mass	– Observe physical phenomena and discuss it as class take note e.g. falling object, rainbow, lightning, electrostatics and refraction. – Use role-play to explain the connection between physics, technology and society. – Use question and answer (Q/A) method to discuss laboratory safety rules. – Use various instruments (metre stick, ruler, screw gauge, vernier caliper, balance, stop watch) to measure time, length and mass of various objects and record in table format. – Determine the volume of a

quantities. – Introduce international system (SI) of measurements units. – State and explain basic laboratory safety rules – State /recall $\rho = \frac{m}{V}$	measuring instruments. – Measure physical quantities: length, volume, mass, time and density and express findings in appropriate units. – Relate Physics with observed phenomena – Predict body floats in water based on its density. – Convert other metric units to SI units	mathematical formulae. – Appreciate the importance of accurate measurements. – Make a judgment of the usefulness of measurement obtained from experiments. – Develop the skills of observation, , recording, analysing Interpretation and verification.	and time (meter stick, ruler, screw gauge, vernier calliper, balances, electronic balances and stop watch). – Derived quantities (volume, weight, density, area, and force). – International system of units (SI) – Metric prefixes in everyday use name, symbol and factor): Nano, Micro, Milli Centi , Deci,Deca ,Hector, Kilo, Mega and Giga. – Experiments on density – Solve numerical problems on density (using $\rho = \frac{m}{V}$)	solid body of regular and irregular shape using displacement method (a Eureka can or a calibrated cylinder) and discuss limitation of the method. – Search Internet for information on measurements of physical quantities.
Links to other subjects: *Science process and safety rules in Biology, chemistry, Mathematics (measurements) Home science (measurements and precision) Geography (area of a given space), primary science.*				
Assessment criteria: *The learner should outline the benefits of Physics to mankind**,** carryout experiments and report the results can use various measuring instruments to measure physical quantities and express findings in appropriate units.*				
Materials: *Sample scientific reports and laboratory safety rules manual, glass beakers, water, wood blocks, vernier calliper, micrometre screw gauge, marbles, metallic weights, thread, stop watch, balance scales, eureka can, measuring cylinder, different objects to be measured.*				

TOPIC AREA: MECHANICS.		
S1 PHYSICS	**Unit 2:** Qualitative analysis of linear motion.	**Nº of periods: 15**
Key unit competence: By the end of the unit the learner should be able to describe objects in motion in one dimension using the principles of kinematics.		

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define and explain the terms: trajectory, displacement, distance, velocity, speed and acceleration. – State the difference between velocity/-speed and displacement/ distance – Calculate speed. – Recall formulae of speed/velocity and acceleration.	– Explain terms used in rectilinear motion. – Calculate the time required to cover a certain distance if the average speed is given. – Calculate displacement, velocity and acceleration. – Plot and interpret a distance/time graph, displacement/time, a speed/time graph, velocity/time graph. – Recognise from the shape of a speed/time graph that a body is at rest, moving with	– Appreciate trajectories of moving bodies. – Appreciate effective ways of crossing roads using the shortest distance between two points. – Adapt scientific skills in estimating the speed of approaching cars to avoid road accidents.	– Define displacement, velocity, speed, distance, and acceleration. – Define motion and list types of linear motion. – Distinguish between instantaneous and average speed, velocity and acceleration. – Plot graphs of distance against time, displacement against time, speed against time, and velocity against time – Formulae of linear motion. – $speed = \frac{Total\ dis\tan ce}{Total\ time}$ – $acc = \frac{velocity}{time}$ – Graphs of distance, speed and acceleration against	– Discuss in group approaches of crossing roads to avoid accidents. – Discuss different terms of rectilinear motion. – Working in a group to solve problems related to distance, speed and acceleration of a moving object. – Measurement of g (acceleration due to gravity) – Draw and analyse distance-time graphs, displacement – time graphs, velocity – time graphs and acceleration time graphs.

	constant speed moving with changing. speed		time.	
Links to other subjects: *(Biology) blood circulation, reflex action, (Mathematics) Moving bodies, arithmetical operations and use of equations and formulae in calculation (Entrepreneurship and business) transport.*				
Assessment criteria: *Learner can explain the relation between distance, speed and acceleration can solve and discuss problems involving distance, speed and acceleration.*				
Materials: *stopwatches, rulers, tape measures, string, spread sheet, solid object, trolleys.*				

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: FORCES	
S1 PHYSICS	**Unit 3:** Force (I)	**Nº of l periods: 10**

Key unit competence: By the end of this unit the learner should be able to define explain and describe forces and their effects.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define and explain the concept of force. – Identify different types of forces in nature. – Represent a force as a vector. – Combine parallel forces and non parallel forces using parallelogram method and scale drawing. – Demonstrate the effect of balanced and unbalanced forces.	– Evaluate the effects of an applied force. – Analyse and combine forces. – Measure force using a spring balance. – Explain natural phenomena depending on force concept. – Choose instruments for measuring weight and mass.	– Appreciate effects of forces in nature – Appreciate the effect of gravity on bodies near the earth surface. – Develop responsible behaviour based on the knowledge of effects of forces. – Cooperate to demonstrate force combination.	– Definition of force. – Types of forces and difference between contact and non contact forces. – Resultant force and turning effect. – **Contact forces** (friction force, tension force, normal action force, air resistance, up thrust, action and reaction force, extension force) and **non-contact** forces (gravitational force, electric force and magnetic force). – Representation of forces using vectors diagrams. – Addition of parallel and non parallel forces.	– Working in groups, learners observes change in of position or shape of a body due to force effect. – Working in groups learners discuss contact and non-contact forces – Use group work to solve problems involving addition of forces. – Pairing up in two groups to illustrate the effects of balanced and unbalanced forces. – Solve problems – Report observations and demonstrations of forces.

Links to other subjects: *Geography (landform formation, ocean currents, solar system etc), Mathematics (vectors addition and scale drawing).*

Assessment criteria: *Learner can explain clearly the concept of forces, can solve problems involving combined forces, can illustrate and report demonstrations related to combine forces effectively.*

Materials: *plastic rubber bands, rope, sponge, spring balance, beam balance, wood, rulers and charts.*

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: FORCE	
S1 PHYSICS	**Unit 4:** Newton's Laws of Motion (I)	**Nº of periods: 10**

Key unit competence: By the end of this unit the learner should be able to state Newton's laws to describe the effects of forces on objects.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain the effect of force on the direction and state of a body. – Define Acceleration, action and reaction, inertia, net force, free body diagram. – State Newton's three laws of motion.	– Observe and interpret change of position of a body due to force acting on it. – Conduct appropriate experiments illustrating Newton's laws of motion. – Solve simple problems involving Newton's laws of motion.	– Appreciate applications of Newton's laws of motion. – Appreciate the need to observe and report. – Acquire ability to think logically and systematically in pursue of particular thought. – Recognize the value of applying the scientific method in solving problems.	– Relationship between mass and inertia. – Newton's First law (law of inertia). – Newton's Second law (impulse) F= ma. – Newton's Third law (principle of action and reaction). – Newton's law of universal gravitation $F = \frac{Gm1m2}{d^2}$ – Weight= mg. – Applications of Newton's law of motion on frictionless horizontal surface. – Determination of acceleration due to gravity an bodies using – $g = \frac{Gm}{d^2}$	– Discuss in groups Newton's law s of motion and make presentations. – Work in groups to perform experiments related Newton's law s of motion and make presentations. – In groups to solve simple problems related to applications of Newton's law of motion. – Calculate weight of bodies on different planets. – Compare gravitational forces between Earth and sun and between earth and moon. – Use Internet search engines to get more details of Newton's laws of motion. – Use simulations and scientific skills to demonstrate Newton's law of motion report and interpret the results.

Links to other subjects: *Linear motion, transportation in entrepreneurship, Sports (Running and jumping).*

Assessment criteria: *Learner can solve and explain problems that involve application of Newton's laws of motion in one dimension* *Can perform simple experiments related to Newton's laws of motion.*
Materials: *Stopwatches, rulers, Spring balance, string, body, inclined plane, beam balance and trolleys.*

TOPIC AREA: MECHANICS	**SUB-TOPIC AREA: FORCE**	
S1 PHYSICS	**Unit 5**: Centre of gravity	**Nº of periods: 10**

Key unit competence: By the end of the unit the learner should be able to determine the position of centre of gravity of a body

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Differentiate between centre of mass and centre gravity. – Define centre of gravity and determine its position for objects of regular shape. – Identify position of centre of gravity for bodies of different shapes.	– Predict the equilibrium of body based on position of centre of gravity. – Apply knowledge of centre of gravity and centre of mass to state equilibrium of a body (stable, neutral, unstable). – Describe the working of toys with in relation to equilibrium. – Determine experimentally the position of centre of gravity for bodies of different shapes (Regular and Irregular).	– Appreciate the role of centre of gravity in determining the stability of a body. – Recognize that when there is no resultant force and no resultant turning effect a system is in equilibrium Accept that position of centre of gravity of a body determines its state of equilibrium. – Recognise c.o.g (centre of gravity) of uniform triangular, circular or rectangular shaped bodies. – Show concern about stability of bodies in particular positions.	– Definition of Centre of mass and centre of gravity. – Determine experimentally of position of centre of gravity of lamina (regular and irregular). – Discuss effect of position of the centre of gravity to the stability of simple objects. – Differentiate between centre of mass and centre gravity. – State of equilibrium of a body with no resultant force or turning effect acting on it.	– Carryout experiment to determine the position of centre of gravity of a lamina. – Make presentations about states of equilibrium for different shapes. – Role play about states of equilibrium in relation to position of cog and resulting consequences unstable equilibrium. – Use internet to search for information on determination of centre of mass and gravity.

Links to other subjects: *Carpentry (stability of different furniture), design of racing cars and modern bus.*

Assessment criteria: *Learner should explain the difference between centre of mass and centre of gravity, conduct and report on experiment to determine centre of gravity , discuss the states of equilibrium in relation to the positions of centre of gravity.*
Materials: *Spherical, conical and triangular objects, metre ruler, Bunsen burner, wood blocks, plumb line, regular and irregular shaped lamina of cardboard.*

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: WORK, POWER AND ENERGY.	
S1 PHYSICS	**Unit 6:** Work, Power and Energy(i)	**Nº of periods: 14**

Key unit competence: By the end of the unit the learner should be able to analyse the process of energy transformations and conservation.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain the concepts of work, power and energy. – Identify forms of mechanical of energy. – Explain transformation of energy. – Illustrate how potential energy changes into kinetic energy and vice versa. – State the law of conservation of energy. – Enumerate types of energy and their sources. – Identify ways of conserving energy.	– Estimate the kinetic and potential energy of bodies in different situations. – Solve problems related to work, power and energy. – Estimate power of an individual climbing a flight of steps. – Calculate the work done on an object pulled a along a horizontal surface using a spring balance. – Analyse the process of energy transformation. – Describe ways of conserving energy. – Explain the principle of energy	– Appreciate the role of work, power and energy in our daily life. – Use correctly the terms work power and energy in a scientific context. – Optimize the efficiency in relation to work, energy and power. – Be aware of danger of high-speed objects or falling objects. – Show concern about shortage of energy sources in our country.	– Forms of energy (potential energy, kinetic energy, light energy, heat energy, sound energy, electrical energy, mechanical energy and chemical energy). – Transformation of kinetic energy to potential energy and vice-versa. – Sources of energy: Electrical energy; light energy, Chemical energy, Solar energy, Wind energy; Biogas energy, Geothermal energy, Methane, Thermal energy, Flowing water, Wood; Nuclear fuels like Uranium. – Different ways to conserve energy. – Law of conservation of mechanical energy.	– Work in groups to determine the work done by pulling an object along a horizontal surface using a spring balance. – Use stopwatch and flight of steps to estimate ones power – Use group work to investigate the effect of falling objects from different heights on a surface. – Devise on typical example of energy transformation. – Group discussion on energy transformation potential energy to kinetic energy and vice-versa. – Discuss in groups' energy sources and ways of energy conservation. – Carry out experiment highlighting the process of energy transformation e.g. simple pendulum, – Search Internet for details on conservation of mechanical

	conservation.			energy.
Links to other subjects: *Building construction, agriculture, engineering, aviation industry.*				
Assessment criteria: *Learner should explain the process of energy transformation and energy conservation; solve problems of energy transformation and energy conservation, can perform and report experimental work related to energy transformation.*				
Materials: *spring balance, solid objects, stopwatch, battery, capacitors, pendulum bob, non-extensible thread.*				

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: WORK, ENERGY AND POWER	
S1 Physics	**Unit 7:** Simple Machines (I)	**Nº of periods: 10**

Key unit competence: By the end this unit the learner should be able to analyse relationship between among energy, work and power for simple machines.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Outline examples of simple machines. – Explain the principles behind simple machines used in daily life. – Define machine, work, energy, power and efficiency of machines. – Determine output work of simple machines.	– Explain the working principles of simple machines. – Explain efficiency of simple machine. – Evaluate efficiency of simple machines. – Use simple machine to perform a given task. – Design and use simple machines. – Solve problems on simple machines.	– Appreciate the importance of simple machines in our daily life. – Recognize the work output of simple machines. – Recognize the effect of friction on efficiency of simple machines.	– Definition of simple machine. – Examples of simple machines (level, pulley, wedge, wheel and axle, inclined plan, screw). – Working principle of lever, a pulley and an inclined plane wheel and axle, screw. – Machine work out and friction in the machine. – Mechanical advantage and velocity ratio of a machine. – Determination of output of simple machine (Efficiency) – Experiment to efficiency of simple machines.	– Discuss different examples of simple machines. – Group presentation of applications of simple machines. – Experiment and demonstration of how a simple machine makes work easy. – Design simple machines and use them to perform tasks. – Solve problems on simple machines. – Use computer simulations to demonstrate advantages of simple machines. – Use internet to access information on simple machines.

Links to other subjects: *Chemistry (metal extraction), English (vocabulary), agriculture (agricultural tools).*

Assessment criteria: *Should explain working principles of simple machines; can solve problems on simple machines, can construct a simple machine and apply them.*

Materials: *Different types of levers pulleys, inclined plane and spring balance, soda opener, knife, wheelbarrow, bicycle.*

<table>
<tr><td colspan="2">TOPIC AREA: THERMAL PHYSICS</td><td colspan="2">SUB-TOPIC AREA: BASIC PROPERTIES OF MATTER</td></tr>
<tr><td colspan="2">S1 PHYSICS</td><td>Unit 8: Kinetic theory and states of matter</td><td>Nº of periods: 10</td></tr>
<tr><td colspan="4">Key unit competence: By the end of this lesson the learner should be able to relate physical properties of solids, liquids and gases to temperature.</td></tr>
<tr><td colspan="3">Learning Objectives</td><td rowspan="2">Learning Activities</td></tr>
<tr><td>Knowledge and understanding</td><td>Skills</td><td>Attitudes and values</td><td>Content</td></tr>
<tr><td>– Describe physical properties of matter.
– State physical properties of matter.</td><td>– Classify materials using physical properties.
– Explain physical properties of solids, liquids and gases using the kinetic theory of matter.
– Separate mixture using physical properties
– Determine boiling point and melting point of different substances.
– Perform an experiment to illustrate viscosity.</td><td>– Appreciate the application of properties of materials in daily life.
– Show concern on how to use different materials in daily life
– Show concern on the use of solid materials based properties of stiffness, sharpness and softness.</td><td>– Simple kinetic theory.
– Description of physical properties of solids (hardness, malleability, conductivity, elasticity, melting).
– Description of physical properties of liquids (viscosity, melting point, boiling point, freezing point and density).
– Description of physical properties of gases (Compressibility).
– Application of physical properties (Filtration and Distillation).
– Recognize Physical properties of matter.</td><td>– Observe difference in viscosity of water and honey.
– Observe difference of stretching materials and analyse their elasticity.
– Investigate boiling and melting points of different substances.
– Perform class experiment to separate mixture considering their physical properties.
– Perform an experiment to illustrate viscosity in fluids.
– Use Internet sites to get information on physical properties of solids, liquids and gases.</td></tr>
<tr><td colspan="4">Links to other subjects: English vocabulary, Chemistry (chemical bonding, filtration and distillation).</td></tr>
<tr><td colspan="4">Assessment criteria: Learner should outline properties of the three states of matter, identify and explain physical properties of water, solid and gas, can give examples of materials with different physical properties of hardness, malleability, elasticity and conductivity.</td></tr>
<tr><td colspan="4">Materials: water, honey, oil, springs, container, source of heat, ice.</td></tr>
</table>

TOPIC AREA: THERMAL PHYSICS		**SUB-TOPIC AREA: THERMOMETRY**		
S1 PHYSICS		**Unit 9:** Heat and temperature		**Nº of periods: 10**
Key unit competence**:** By the end of this unit the learner should be able to explain principle of thermometry and compare different temperature scales.				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain the difference between heat and temperature. – Explain temperature as degree of coldness and hotness. – Read temperature from different thermometers. – Explain steps of calibrating a thermometer.	– Evaluate temperatures of different substances. – Differentiate between heat and temperature. – Describe different thermometer scales and thermometric liquids used. – Convert temperature from one temperature scale to another. – Determine the boiling and melting points of candle	– Appreciate the applications of measuring body temperature. – Appreciate that feeling cold and hot is subjective. – Recognize the advantages of mercury over alcohol as a thermometric liquid.	– Heat as a form of energy. – Difference between heat and temperature, – Temperature scales (Kelvin ,Fahrenheit, Celsius, Reaumur). – Types of thermometers (Laboratory and Clinical thermometer, maximum and minimum). – Measurement of temperature of substances. – Thermal equilibrium. – Functioning of thermometers. – Liquids for thermometers (advantages and disadvantages). – Temperature conversion	– Use group activities to investigate melting and boiling point of different liquids. – Working in groups, learners discuss degree of hotness and coldness and make presentations. – Working in groups, learners convert temperatures between different scales. – Group discussions on advantages of different types of thermometric liquids. – Use Internet to search for simulations on the principle of thermometry.

	wax, methyl spirit, water).		– Effects of solutes on boiling points of liquids	
Links to other subjects: *Use of thermometers in medicine, geography, agriculture, and all sciences.*				
Assessment criteria: *Learner* ***can*** *identify, explain and describe different types of thermometers and liquids used in the thermometers. Can convert different temperature from one scale to another.*				
Materials: *Different types of thermometers, salt, mercury, alcohol, vessels (cylindrical and flat vessels).*				

TOPIC AREA: ELECTRICITY AND MAGNETISM	**SUB-TOPIC AREA: MAGNETISM**	
S1 PHYSICS	**Unit 10:** Magnetism (I)	**Nº of periods: 10**
Key unit competence: By the end of this unit the learner should be able to differentiate magnetic and non-magnetic materials.		

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– State properties of magnets – Identify the poles of a bar magnet. – Draw magnetic field patterns on a round magnet. – Identify the poles of a bar magnet. – State and explain the basic law of magnetism (attraction and repulsion).	– Predict what happens when a magnet is brought near various solid materials. – Distinguish magnetic and non-magnetic materials. – Identify the poles of a bar magnet using the earth's magnetic field.	– Appreciate application of magnetic materials. – Recognize the importance of magnetism in lifting heavy magnetic materials. – Appreciate the use of magnets in separating magnetic from non-magnetic materials. – Appreciate the existence of magnetic force of attraction and repulsion.	– Definition of a magnet. – Examples of magnetic and non-magnetic materials. – Types of magnets (permanent and temporary magnets). – The poles of a bar magnet (using the earth's magnetic field). – Test for a magnetism.	– Group work to determine the poles of bar magnet – Use the earth's magnetic field to identify the poles of a magnet. – Describe the interactions between magnetic poles. – Experiment to reveal magnetic field patterns using iron filings. – Experiment to plot magnetic field pattern using plotting compass. – Working in groups, suspended magnets freely to identify magnetic and non-magnetic materials. – Working in groups to separate mixture of ferromagnetic materials and non-magnetic materials using magnets. – Access internet for information

				on magnetism.
Links to other subjects: *Chemistry (Kinetic theory of gases, electrons, State of matter) Air and sea navigation, Geography (compass direction and bearing).*				
Assessment criteria: *Learner should distinguish between magnetic and non magnetic materials , define terms related to magnetism and sketch magnetic field patterns.*				
Materials: *Permanent magnet, iron filing, pieces of glass, iron nails, steel pins, plastics, wood, mercury (thermometer), coins, rubber, lead metal, graphite motors, mobile phone, loudspeakers, razor blade.*				

TOPIC AREA: ELECTRICITY AND MAGNETISM.				
S1 PHYSICS	**Unit 11:** Electrostatic (I)			**Nº of periods:** 10
Key unit competence: By the end of the unit the learner should be able to explain charging of materials and distribution of electric charges on conductors.				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Describe atomic structure of atoms. – Identify types of charges. – State the laws of electric charges. – Describe methods of charging. – Explain the principle of charge conservation. – Explain effects of electric charges on a conductor. – Differentiate between insulators and conductors. – Explain factors that affect the	– Explain the fundamental law of electrostatics – Differentiate insulators from conductor – Discuss methods of charging bodies – Demonstrate and explain charge distribution on a conductor. – Evaluate distribution of electrostatic charges on a conductor. – Analysis and critically evaluate electrostatic related issues.	– Appreciate the application of static charges. – Develop positive attitudes of curiosity, honesty, respect for evidence, and perseverance and tolerance in the study of electrostatics. – Show concern on the danger caused by electrostatic charges and be aware of safety precautions to be observed during rainstorms. – Show concern on the use of an electroscope.	– Types of electrostatic charge and SI Units of charge. – Methods of charging bodies (induction, rubbing/friction, and contact). – Laws of electrostatic charges and Coulomb's law. $F = \frac{1}{4\pi\epsilon}\frac{Q_1 Q_2}{d^2}$ – Insulators and conductors. – Electric field and electric potential. $\vec{E} = \frac{\vec{F}}{Q}$ and $V = \frac{1}{4\pi\epsilon}\frac{Q}{d}$ – Distributions of electric charges on metallic conductors Applications of electrostatic charges.	– Discuss methods of charging and report. – Group work to describe electrostatic charging of materials. – Discus and list insulators and conductors. – Group discussion on different phenomena resulting from interaction of electric charges – Group work to find out effects caused by distribution of electric charges on a conductor. – Working in groups compute problems involving attraction and repulsion of two or more charges by using Coulomb's law. – Access Internet for information on electrostatic charges and distribution of

magnitude of force between two charged bodies. – Describe electrostatic phenomena, using, concepts, laws, theories and models. – Recall Coulomb`s law, electric field and potential.				charges on conductors.
Links to other subjects: *Structure of atom (chemistry). Geography (formation of clouds and lightening).*				
Assessment criteria: *Learner can explain electrostatic phenomena and describe charge attraction and repulsion.*				
Materials: *Plastics combs, pieces of paper, polythene rod (ebonite), glass rod, cloths, electroscope, lightening arrestors.*				

Topic Area: ELECTRICITY AND MAGNETISM				
S1 PHYSICS		**Unit 12:** Current Electricity (I)		**Nº of periods: 10**
Key unit competence: By the end of this unit the learner should be able to explain different effects of electricity and safety precautions to observe while using electricity.				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Outline simple electric circuit components and define them. – Explain the functioning of cells and batteries. – Illustrate the effects of electric current (heating, magnetic and chemical). – Explain applications of earth wire, fuse, and circuit breaker in preventing electrical shocks and short circuits. – State and	– Apply the knowledge of electric current in electrolysis. – Set up simple electric circuits. – Explain different effects of electric current. – Distinguish between simple cells and batteries – Apply knowledge of safety precaution to avoid overheating of devices (uses of fuses and circuit breakers). – Explain what would happen to a house without fuses or circuit breakers during electric circuit overload and short-	– Recognize how to measure electric current and potential difference using ammeter and voltammeter. – Appreciate the application of effects of electric current. – Appreciate that chemical reactions produce current. – Appreciate that if electrical circuit is not properly used and controlled, it can cause fires.	– Definition of simple electric circuit and its components. – Electric components used in simple electric circuit.(cells, batteries, wires). – Simple electric circuit diagrams. – Electric current and electric potential difference. – Measurement of current and voltage using Ammeter and Voltmeter. – Ohm's laws: $V = IR$. – Electrical energy and power: $P = VI$. – Effect of electric current (Magnetic effect, Heating (Joule's law $W = I^2Rt$) and Chemical effect of electricity). – Safety precautions to observe when handling electrical appliances. – Experiment to verify Ohm's law.	– Observe and set up simple electric circuits. – Discuss production of current from cells/batteries. – Demonstrate how electricity is used in motors, bulbs, and other devices. – Discuss characteristics of magnetic field produced by current. – Perform experiment to investigate the heating effect of an electric current. – Discuss chemical effect of current (electrolysis) and make class presentations. – Access and search Internet for information on effects of electricity and safety to be taken while using

describe different effects of electric current.	circuiting. – Measure current, voltage and resistance. – Verify Ohm`s law.		– Graphs of voltage against current.	electricity its precautions.
Links to other subjects: *Electrolysis and chemical effects (Chemistry).*				
Assessment criteria: *Learner **can** explain effects of electric current and safety precautions to be taken to avoid electric shocks and circuit overloading.*				
Materials: *Battery/cells, bulb, connecting wire, plotting compass, insulated copper wire, Ammeter, Voltmeter, Ohmmeter, resistors, Electrolytic cell (Voltammeter), switch.*				

TOPIC AREA: LIGHT	SUB-TOPIC: NATURE OF LIGHT	
S1 PHYSICS	**Unit 13:** Rectilinear Propagation of light	**Nº of periods: 10**

Key unit competence: By the end of this unit the learner should be able to explain the nature of light, rectilinear propagation of light and reflection at plane surface.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– State sources of light. – Explain the nature of light. – Describe transparent, translucent and opaque materials. – Explain how light travels in a straight line. – Describe the formation of penumbra and umbra. – State characteristics of images formed by plane mirrors. – State laws of reflection. – Explain applications of	– Identify sources of light. – Show that light travels in straight lines. – Analyze the formation of penumbra and umbra. – Illustrate penumbra and umbra using a torch – Describe the nature of images formed by pinhole camera. – Explain functioning of pin-hole. – Verify experimentally laws of reflection. – Solve problems involving pin-hole camera and mirrors inclined at an angle.	– Appreciate light is important for seeing and photosynthesis. – Adapt the need to report scientifically and critical thinking in performing experiments related to light. – Recognize light travels in straight lines.	– Different sources of light (luminous and non-luminous sources). – Rays and Beams (parallel , converging and diverging). – Classification of materials as Transparent, translucent and opaque. – Experiments on light propagation. – Rectilinear propagation of light. – Types of reflection (Regular and diffuse reflection). – Formation of shadows and eclipses (penumbra and umbra). – Lunar and solar eclipses. – Law of reflection. – Characteristics of images formed in plane mirrors. – Ray diagrams and number of images formed in inclined mirrors.	– Discuss sources of light. – Group presentations on the applications of light. – Demonstrate light is propagated in a straight line. – Make a project that investigates on different sources of light. – Discuss characteristics of image in mirrors – Project works develop pinhole camera or periscope. – Use Internet to search details on light propagation and do presentation.

reflections at plane mirrors. – Describe images formed by a pinhole camera. – State characteristics of images formed by pinhole camera. – Explain applications of light reflected at plane mirror surfaces.			– Pinhole camera image formation and magnification. – $m = \frac{image\ height}{object\ height}$ – Problems on pinhole camera and mirrors inclined at an angle. – Available materials.	
Links to other subjects: *Organic and inorganic (chemistry), Mirror (use in saloon).*				
Assessment criteria: *Learner can describe sources of light and explain its propagation.*				
Materials: *Source of light, three pieces of card each with small hole in the centre, 1 metre of thread, Plasticine, screen, torch, dry cells, dark room, opaque, plane mirrors, soft boards, optical pins*				

5.3. Senior Two

5.3.1. General objectives for senior two

- Validate basic formula based on dimensional analysis.
- Analyze the thermal expansion of solids, liquids and gases.
- Perform experiments on gas laws.
- Magnetise materials using magnets.
- Explain magnetization and demagnetization of magnets.
- Explain the applications of static electricity.
- Analyze resistor arrangement in electric circuits.
- Explain the functioning of basic electronic devices.

5.3.2 Senior Two Units

TOPIC AREA: MECHANICS	**SUB-TOPIC AREA: PHYSICAL QUANTITIES**	
S2 PHYSICS	**Unit 1**: Sources of errors in measurement of physical quantities	**Nº of periods:** 12

Key unit competence: By the end of the unit the learner should be able to identify and explain sources of error in measurements and report.

Learning Objectives			**Content**	**Learning Activities**
Knowledge and Understanding	**Skills**	**Attitudes and values**		
– State and explain types of errors in measurements. – Distinguish between precision and accuracy. – Explain the concept of significant figures. – Explain the error propagation in derived physical quantities. – Explain rounding off numbers. – Explain fundamental quantities and their dimensions. – State the fundamental and the derivate	– Distinguish random and systematic errors. – Choose appropriate measuring instruments. – Report measured physical quantities accurately. – Reduce random and systematic errors while performing experiments. – State correct significant figures of given measurements considering precision required. – Estimate errors on derived physical quantities. – Use dimension	– Appreciate accurate measurements in data reporting. – Develop analytical skills for manipulating measurement to minimize errors. – Be aware of uncertainties when using instruments to get data. – Suggest ways to reduce random errors and minimize systematic errors.	– Types of errors (random and systematic); estimating the uncertainty range (from first principle and from repeated measurements). – Significant figures. – Compare uncertainty in measurements. – Percentage errors. – Compound errors in simple equations. – Rounding off of numbers. – Fundamental quantities and their dimensions – Dimension analysis for given simple equations.	– Group discussion on types of errors in experiment data. – Presentation of types of errors. – Learners work in groups to determine compound errors in single measured physical quantities such as surface area, volume, force etc. – Discuss in groups and report systematic errors found in measuring instruments.

quantities and determine their dimensions.	analysis to verify equations in physics.			
Links to other subjects: *Biology-Chemistry-Medicine (dosage), all social and science subjects. Manufacturing industry (iron sheets, paper and soda).*				
Assessment criteria: *can determine the uncertainty in measured, explain propagated errors and derived physical quantity and report results appropriately.*				
Materials: *ruler, Vernier callipers, micrometer screw gauge, meter rule, balance, watches, ammeter, voltmeter, Ohmmeter, objects to be measured etc.*				

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: MOTION	
S2 PHYSICS	**Unit2:** Quantitative analysis of linear motion	**No. of periods: 10**
Key unit competence: By the end of the unit the learner should be able to analyse and solve problems related to linear motion.		

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define linear motion. – State examples of linear motions. – Explain the difference between instantaneous and average values of speed, velocity and acceleration. – Derive equations of linear motion. – Describe the acceleration of a free falling body near the earth's surface. – Recall the kinematic equations of rectilinear	– Derive equations of linear motion. – State conditions applicable to equations of uniformly accelerated motion. – Distinguish linear motion from other motions. – Describe t the motion of free falling body. – Solve problems related to linear motion.	– Appreciate the scientific techniques applied for bodies to move against gravitational acceleration (in sports, airplanes). – Appreciate the importance of acceleration due to gravity. – Appreciate cooperative skills in solving linear motion problems. – Appreciate sketching of graphs for bodies in motion	– Definition of linear motion. – Types of linear motion. – Kinematic equations of linear motion. – v= $u + at$ – $s = ut + \frac{1}{2}at^2$ – v^2=u²+2as – Acceleration due to free fall. – Simple pendulum experiment to determine "g" for a particular location.	– Observe and discuss linear motion and report. – Discuss linear motion in groups, share ideas and make presentations. – Work in groups interprets and equations of free fall. – Carry out experiment to determine acceleration due to gravity". – Solve problems related to linear motion. – Search Internet for simulations on linear motion.

motions. – Explain effects of air resistance on moving objects.				
Links to other subjects: *Geography (graphs), Mathematics (computation and interpretation of graphs, algebra for equation derivation).*				
Assessment criteria: *Learner* ***c****an analyse and solve problems related to linear motion correctly.*				
Materials: *small mass (pop) stand and clamp, inextensible string scientific calculator, meter rule and stop watch./digital watch.*				

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: FORCES	
S2 PHYSICS	**Unit3**: Friction Force	**Nº of periods: 9**

Key unit competence: By the end of this unit the learner should be able to explain the effects of a force and its importance in life.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– State and explain nature of friction force. – Describe types of friction forces. – Explain effects of friction force. – Discuss advantages and disadvantages of friction forces. – Determine coefficient of friction. – Describe technological applications of friction force.	– Convey the nature of friction force. – Measure static and dynamic friction. – Identify factors affecting friction force. – Methods of reducing friction force. – Solve problems on friction force.	– Appreciate benefits of friction force and its inconveniencies. – Develop scientific attitudes as regards the effects of friction force. – Recognize the importance of friction force on the motion of body. – Be aware of the importance of ones and others safety while walking on frictionless force surfaces.	– Review general forces between contact surfaces. – Effects of forces between surfaces enable walking, lighting of match box etc. – Friction force: change of position (change of position and friction, Coefficient of friction force. – Factors affecting friction force (adhesion, smoothness and roughness, area of contact with surface). – Types of friction force (static and kinetic/dynamic friction). – Effects of friction force. – Advantages and disadvantages of friction force). – Change position or shape of body. – Other resistance forces (	– Perform group experiments to illustrate types of friction forces. – Discuss in groups factors affecting it and report to class – Demonstrate and experiment determination of coefficient of friction force(static and dynamic) – Learner to work in pairs to solve problems related to friction force.

			tension, action and reaction, air resistance, viscosity, gravitational, electric and magnetic). – Experiment to determine coefficient of friction (μ_d and $\mu_{s)}$	
Links to other subjects: *Mathematics (moving bodies), Physical education (athletics), Chemistry (organic chemistry manufacture of tires).*				
Assessment criteria: *Learner can describe and explain clearly friction force and its applications.*				
Materials: *wooden block (with smooth and rough surfaces) spring balance, thread, single pulleys and standard mass, lubricants.*				

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: FORCE	
S2 PHYSICS	UNIT 4: Density and Pressure in Solids and Fluid	Nº of periods: 9

Key unit competence: By the end of this unit the learner should be able to define pressure and explain factors affecting it.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Outline common observations of pressure (ducks web legs, camel's/elephant's wide pads, heavy lorries have many tyres). – Define and explain the pressure as a relationship of force acting on a surface area. – Identify force and area as factors affecting pressure in solids. – Give the relationship between force, pressure and area. – Explain how pressure varies with force and area of contact – Describe liquid (mercury) in glass barometer.	– Describe the pressure in terms of force and area, and do calculations using the equation – Pressure = force/area and – P = ρgh – Solve problems using P = ρgh. – Explain change in pressure by reducing or increasing area of contact and vice versa. – Measure pressure air using simple manometer.	– Appreciate achieving desired pressure by varying parameters of area and force. – Recognise variation atmospheric pressure with altitude. – Appreciate that a big force applied a small area of contact produces higher pressure.	– Force acting on a surface – Definition of pressure and its S.I. units – Pressure in solid $P=\frac{F}{A}$(force acting normally or perpendicular to surface) – Pressure in fluids liquids and gases (density $P = \rho gh$ – Relative density, and relationship between density and pressure, Hydrostatic pressure p = ρgh. – Archimedes principles, sinking and floating. – Atmospheric pressure and height/altitude above sea level.	– Working in groups learners determine pressure exerted on a wooden surface by given forces. – Discuss and explain relationship between pressure, force and contact area. – Solve problems involving equation of pressure. – Carry out experiments in groups to determine the pressure exerted surface area and report. – A can/ plastic bottle crushing experiment (deformation) experiment. – Calculate relative density of different bodies – Search internet for more applications of pressure.

– Explain floating and sinking phenomena using density. – Explain measurement of atmospheric pressure using liquid in glass barometer. – Explain the functioning of aneroid barometer. – Describe and explain pressure transmission in hydraulic systems. – Explain functioning of a hydraulic press and hydraulic brakes .	– Measure atmospheric pressure using barometer.			
Links to other subjects: *Chemistry (chemical reactions releasing gases), and Biology (human blood pressure) and Geography (atmospheric pressure and volcanic eruptions) Air navigation(height above sea level determined by altimeter).*				
Assessment criteria: *Learner can explain the relationship between pressure, force and area of contact, can solve problems involving pressure, force and area, can conduct experiment on pressure and report.*				
Materials: *sponge, nail/pins, wooden surface two identical bricks, fine sand, spring balance, u-tube, tin/cans/plastic bottle with holes on the side (vertical and level).*				

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: PRESSURE	
S2 PHYSICS	**Unit 5:** Measuring liquid Pressure with Manometer	**Nº of periods: 9**

Key unit competence: By the end of this unit the learner should be able to explain the working principle of manometer use to measure the pressure in fluids.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Describe a manometer. – Explain the principle of a manometer. – Explain hydrostatic pressure and atmospheric. pressure and their measurement. – Explain equilibrium of a liquid at rest in a vessel and communicating container.	– Explain why a liquid surface is an isobar and state its application. – Analyze the equilibrium of non-miscible liquids in a container and in communicating container. – Solving problems on a manometer.	– Appreciate the benefits of pressure measurement. – Recognize the application of same level of liquid in communicating vessels. – Appreciate the results of measurement of liquid pressure using a manometer. – Realize the use of pressure in everyday activities (aviation, automobile, sports).	– Definition of hydrostatic Pressure. – Description of equilibrium of a liquid at rest in container. – Description of equilibrium of a liquid in communicating container. – Hydrostatic paradox in communicating vessels. – Equilibrium of non- miscible liquids in a container and in communicating vessels. – Hare`s apparatus. – Measuring pressure using a Manometer. – Problem solving on a manometer.	– Perform in experiment in groups to demonstrate that pressure in fluid depends on the height/ column not on the shape of the vessels. – Make group demonstration of the existence of pressure in a fluid at rest in a container. – Working in small groups and do an experiment to determine pressure using a manometer.

Links to other subjects: *Biology (medicine), navigation, water supply tanks.*

Assessment criteria: *Learner can explain clearly the working principle of a manometer and use it to determine pressure of a liquid.*

Materials: *level indicator, manometer, Pascal's vessel, gas, water, mercury and alcohol.*

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: FORCE	
S2 PHYSICS	**Unit 6:** Application of Pascal's principle	**Nº of periods: 10**

Key unit competence: By the end of the unit the learner should be able to explain transmission of pressure in fluids at rest and describe its applications.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain static pressure of fluids at rest. – Describe transmission of pressure in static fluids. – Explain Pascal's principle. – State applications of Pascal's principle. (Hydraulic press, Hydraulic brake, Water Towers, Hydraulic jack.)	– Illustrate Pascal's principle. – Explain transmission of pressure in fluid at rest. – Explain Pascal's principle. – Explain the functioning of hydraulic jack. Lift and dump it truck and car brakes.	– Appreciate pressure exerted on an enclosed fluid is equally transmitted in all directions. – Appreciate that pressure transmitted in a fluid produces a large force when a small force is applied to it.	– Static pressure in fluids at rest – Transmission of pressure in fluids. (Pascal's principle) – Applications: hydraulic press, hydraulic brakes, hydraulic lift pump, Water Towers, hydraulic jack.	– Discus how pressure is transmitted in fluids. – Demonstrate Pascal's principle using enclosed fluid. – Devise experiment to illustrate the functioning of hydraulic brakes. – Discuss in groups the functioning of hydraulic car jack.

Links to other subjects: *Biology (blood circulation), Medicine (transmission of serum to patient).*

Assessment criteria: *Learner can clearly explain transmission of pressure in fluids at rest and describe related applications.*

Materials: *Pascal's vessels, gas, water, alcohol, hydraulic press, car jack, syringe.*

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: PRESSURE	
S2 PHYSICS	**Unit 7:** Archimedes principle and atmospheric pressure	**Nº of periods: 10**

Key unit competence: By the end of the unit the learner should be able to be able to determine atmospheric pressure using barometer.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain atmospheric pressure and state its units. – Explain applications of atmospheric pressure. – Illustrate Archimedes principle in air. – Explain buoyant/up thrust force and Archimedes principle in liquid. – Realize the applications of Archimedes principle in air.	– Carry out an investigation on the existence of atmospheric pressure. – Solve problems related to atmospheric pressure. – Derive the relation P = ρgh – Solve problems related to density and height of fluid. – Describe the phenomena of floating and sinking. – Carry out an investigation on how atmospheric pressure varies with altitude.	– Appreciate applications of atmospheric pressure. – Develop positive attitude of curiosity and respect for evidence atmospheric pressure. – Appreciate that fluids can support bodies.	– Existence of atmospheric pressure – S.I. units of atmospheric pressure. – Instruments for measuring atmospheric pressure. – Applications of atmospheric pressure. – Archimedes principle in fluids: up thrust, factors affecting up thrust, state principle and formula. – Application of Archimedes principle: floating and sinking. – Archimedes principle in air – Applications of Archimedes principle in air. (Aerostat, Baroscope) – Solve problems on Archimedes' principle	– Devise experiment to demonstrate the existence of atmospheric pressure. – Investigate operation of Barometer and use it to measure atmospheric pressure. – Make group discussion and presentation on Torricelli's experiment on a barometer. – Search Internet for applications of atmospheric pressure and Archimedes applications. – In groups discuss why sink object or float in fluids. – Carry out an experiment to verify Archimedes principle and write a report. Solve problems related to Archimedes principle.

Links to other subjects: *Biology (Gas exchange) Food Industry (Using straw to take soda) Education (Filling pen with ink), Aircraft (pressurizing aircraft cabin) Meteorology (weather forecast).*

Assessment criteria: *Learner can demonstrate clearly the existence of atmospheric pressure and verify Archimedes principle.*
Materials: *Mercury and open glass tube about 1 metre long, Hydrometer, Barometers, balloons, Magdeburg hemispheres, metal can/plastic container, drinking straws, spring balance, spirit, water, electronic balance.*

TOPIC AREA: MECHANICS	**SUB-TOPIC AREA: WORK, POWER AND ENERGY**	
S2 PHYSICS	**Unit 8:** Work, Power and Energy. (II)	**Nº of periods: 9**

Key unit competence: By the end of unit the learner should to be able to relate work, power and energy.

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Recall the knowledge on energy, work and power. – Explain the terms work, power and energy. – Describe notations/symbols used in relating work, power and energy. – Explain the relationship between work, power and energy.	– Derive the equations relating work and power. – Analyse relationship between work and power. – Relate power and energy. – Compare work, power and energy.	– Appreciate the importance of energy and power for efficiency working of machines. – Show concern of work as a product of distance and energy. – Be aware of the social, economical, environmental and technological implications of studying work energy and power. – Acquire an analytical mind to critically evaluate work, energy and power-related issues.	– Equations relating work and power. – Work: Definition, formula and its SI units. : W= F.d – Power: Definition, formula and its SI units. $P = \frac{W}{t}$ – Energy: Definition, formula and its SI units. E_p= mgh; $E_k = \frac{1}{2}mv^2$ – Relationship between work and power. – Relationship between power and energy. – Relationship between work and energy. – Measurement of personal power.	– Discuss in groups and make presentation on the relation between work, power, and energy. – Solve in groups problems on work, power and energy. – Search Internet for simulations on machines performing work. – In groups estimate personal power, discuss and present results.

Links to other subjects: *Chemistry (chemical reactions), mathematics (graph interpretation).*

Assessment criteria: *Learner can correctly establish relationship between work, power and energy, and solve related problems.*
Materials: *Pulleys, Levers, wedge, screws, compound machines (an apple peeler), masses s and inclined plane.*

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: ENERGY.	
S2 PHYSICS	**Unit 9:** Conservation of mechanical energy in isolated systems.	**No. of periods: 10**

Key unit competence: By the end of this unit the learner should be able to apply the principle of conservation of mechanical energy for isolated system.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define terms associated with isolated system and open system. – Describe an isolated and open system. – State different forms of mechanical energy. – Differentiate kinetic and potential energy. – Explain conversion of kinetic energy into potential energy and vice versa. – State principle of conservation of energy.	– Identify different forms of mechanical energy – Apply the principle of conservation of mechanical energy in solving problems. – Discuss applications of principle of conservation of mechanical energy to isolated system.	– Appreciate the application of the principle of conservation of mechanical energy. – Realize that kinetic energy can be converted into potential energy and vice versa. – Predict consequences of law of conservation of mechanical energy on an isolated system.	– Isolated and open systems. – Kinetic and potential energy of a system. – Types of potential energy. – Convert potential energy into kinetic energy and vice versa. – Conservation of mechanical energy law. – Applications of law of conservation of mechanical energy.	– Working in groups carry out experiments demonstrate to conservation of mechanical energy and report. – Discuss in groups energy conservation and make presentations. – Perform experiments on energy conversion (potential energy into kinetic energy and vice versa) and report. – Search Internet for details on principle of energy conservation for an isolated system.

Links to other subjects: *Ecology (Total energy in the universe) chemistry (Chemical reactions in isolated systems).*
Assessment criteria: *Learner can explain clearly the principle of energy conservation and discuss implications of energy conservation in the environment.*
Materials: *simple pendulum, masses, bow, and catapult.*

TOPIC AREA: THERMODYNAMICS		**SUB-TOPIC AREA: GAS LAWS**		
S2 PHYSICS		**Unit 10:** Gas laws' experiments		**Nº of periods:** 10
Key unit competence By the end of the unit the learner should be able to describe and analyse gas laws experiments.				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– State and explain the behavior and properties of an ideal gas. – Discuss equation of perfect gas. (Ideal gas). – Define Boyle`s law, Charles`s law, pressure law, and Dalton`s law. – Recall the gas law equations.	– Design experiment to verify Boyle's law, Charles's law and pressure law. – Explain equations of perfect gas. (Ideal gas) – Discuss the gas laws. – Interpret experiments for gas laws. – Evaluate experiment to verify Dalton's law of partial pressure. – Solve and interpret problems using gas law equations. – Describe how a change in volume of a fixed mass of gas at constant	– Appreciate applications of gas laws. – Appreciate; think logically and systematically when relating gas laws. – Adapt scientific method apply in solving gas problems – Adapt scientific methods in analyzing, modeling and establishing the dimensions of gas laws.	– Gas laws (pressure, volume and temperature). – Boyle's law(Compressibility of gas) – Charles' s law and Pressure law. – Ideal gas /Perfect gas equation. – Dalton's law of partial pressure. – And density of gases. – Boyle`s law Pv=Constant – $p_1V_1 = p_2V_2$ – $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	– Perform experiments to verify Boyle's law, Charles's law and Pressure law and report results. – Perform experiment to verify Dalton's law of partial pressure and report. – Solve problems on gas laws. – Search internet for simulations on gas laws.

	temperature is caused by a change in pressure applied to the gas.			
Links to other subjects: *Chemistry (gases), Mathematics (graphs interpretations).*				
Assessment criteria: *Learner can perform and describe experiments for Boyle's law, Charles law and Pressure law, solving problems involving gas law equations.*				
Materials*: Glass tube, mercury, barometer, rubber tube or plastic tube, gas, burette, glass beaker, calcium chloride (drying agent), thermometer, clip, concentrated sulphuric acid, Bunsen, pipette, hydrogen balloon, glass bulb, capillary tube, tap air, pump.*				

TOPIC AREA: ELECTRICITY	**SUB-TOPIC AREA: MAGNETISM (II)**	
S2 PHYSICS	**Unit 11:** Magnetization and Demagnetization	**Nº of periods:** 7

Key unit competence: By the end of this unit the learner should be able to describe methods of magnetization and demagnetization

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Review previous knowledge of magnets. – Describe the magnetic properties of iron and steel. – Describe the methods of magnetizing and demagnetizing of materials. – Explain use of keepers in storing magnets. – Explain magnetic shielding.	– Explain magnetization using the domain theory. – Create a temporary and permanent magnets. – Describe methods demagnetizing magnets. – Explain demagnetization using the domain theory. – Discuss methods of storing magnets.	– Appreciate the applications of magnets. – Be aware of the social, economic, and technological implications of using magnets. – Recognize the role of electromagnets in making electrical devices.	– Structure of an atom. – Magnetic domains. – Methods of magnetization (stroking, electrical and earths magnetic field) and demagnetization (Heating, hammering, AC current). – Methods of demagnetization. – Magnetic Keepers. – Magnetic shielding.	– Discuss in groups magnetization of ferromagnetic materials and report. – Group discussion and presentations on demagnetization. – Create sculpture from magnets and suggest how other materials that can be used. – Search Internet for additional information on magnetization and demagnetization of magnets.

Links to other subjects: *Chemistry (structure of the atom, electron spin) Banking (ATM-cards) Computer Science (Information storage CDs, magnetic tapes).*

Assessment criteria: *Learner can explain and describe clearly the methods of magnetization and demagnetization.*

Materials: *Magnet, hummer, iron filings, soft iron, steel metal, Computer CDs, magnetic tapes, metallic wrist watches AC and DC power supplies.*

TOPIC AREA: ELECTRICITY	**SUB-TOPIC AREA: STATIC ELECTRICITY**	
S2 PHYSICS	**Unit 12:** Applications of Electrostatic	**Nº of periods: 10**
Key unit competence: By the end of this unit the learner should be able to explain applications static charges.		

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain and describe distribution electric charges metallic conductors. – Explain electric force, electric field and electric potentials. – Discuss applications of electrostatic.	– Define electric field strength. – Relate electric field patterns and charge distribution on conductors of different shapes. – Evaluate applications of electrostatics in other fields (agriculture, environment, industry).	– Appreciate the applications of electrostatics. – Appreciate the need to find other applications of electrostatic. – Realize possible hazards related to electrostatic and how to avoid them.	– Electric field. – Electric field patterns. – Electric Potential, – Charge distribution (spherical, pear, cylindrical, and sharp pointed). – Applications of electrostatics: point discharge (lightning). – Lightning Arrestors – Paint spraying, Photocopy Machines /Xerography and Laser Printers. – Van de Graff Generator, Electrostatic precipitator, (dust particle collection and separation).	– Work in groups and make presentations on experiments illustrating electric force, electric field and electric potential. – Discuss in groups ways of separating a mixture by applying an electric field. – Discuss in pairs various applications of electrostatic – Search Internet for electrostatic and its applications.

Links to other subjects: *Medicine (separation of haemoglobin and plasma), chemistry (spectrometer) and Biology (replication of DNA).*
Assessment criteria: *Learner can explain clearly concept of electrostatics and its applications.*
Materials: *Electroscopes, Van de Graff generator, ebonite rods, glass rods, treads, silk, animal fur and photocopy machine.*

TOPIC: ELECTRICITY	**SUB-TOPIC: DIRECT CURRENT**	
S2 Physics	**Unit 13:** Arrangement of resistors in electric circuit.	**Nº of periods:** 10

Key unit competence: By the end of this unit the learner should be able to describe arrangement of resistors in a simple electric circuit

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Arrange resistors in simple electric circuit. – Explain the magnetic effect of electric current. – Explain how grounding, fuses, and circuit breakers protect people against electrical shocks and short circuits. – State and explain the effect of electric current.	– Analyse arrangement of resistors in simple electric circuit. – Construct simple electric circuit with resistors in series and parallel, ammeter and voltmeter. – Illustrate the effect of electric current. – Apply knowledge of safety to prevent circuits from overheating devices (fuses and circuit breakers). – Predict what would happen in a house without a fuse or circuit breakers with overloaded	– Appreciate the importance of effects of electric current in our daily life. – Recognize and avoid risks involved with the electrical circuit. – Acquire ability to think logically and systematically pursue a line of thoughts. – Adapt scientific method of thinking. – Acquire knowledge in analyzing and modeling physical processes.	– Arrangement of resistors in simple electric circuit. – Electric potential and electric potential difference – Ohm's laws. – Electrical energy and power. – Effects of electric current: Magnetic effects. – Heat Effects and Chemical effect of electricity – Electric bell, electromagnet –	– Construct simple electric circuit with resistors in series and parallel, ammeter and voltmeter. – Discuss in groups the characteristics of a magnetic field produced by a current and make presentation. – Perform experiment to investigate the heating and magnetic effect of an electric current and report. – Carryout an investigation on chemical effect of current ie Electrolysis.

	electric circuit. – Measure electric current and potential difference using ammeter and voltammeter.			
Links to other subjects: *Chemistry (chemical changes, liquids, acids, electrons, electrodes), Mathematics (graphs).*				
Assessment criteria: *The learners can construct simple electric circuit with resistors in series and parallel, ammeter and voltmeter.* *Perform experiment to investigate the heating effect of an electric current.*				
Materials: *Battery, bulb, connecting wire, magnetized needle, insulated copper wire, Ammeter, Voltmeter, Ohmmeter, resistors, Electrolytic cell (Voltammeter).*				

TOPIC AREA: LIGHT	SUB-TOPIC AREA: REFLECTION	
S2 PHYSICS	**Unit 14:** Reflection of light in curved mirrors	**Nº of periods: 10**
Key unit competence: By the end this unit the learner should be able to analyse applications of reflected light.		

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Recall reflection of light in plane mirrors. – Recall laws of reflection of light in plane mirrors. – Discuss terms used in curved mirrors. – Describe the formation of images by spherical mirrors. – Give the applications of spherical mirrors. – Recall $\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$ and $m=\frac{v}{u}$	– Evaluate images formed by curved mirrors. – Locate by construction images formed in curved mirrors and state their characteristics. – Perform an experiment to determine the focal length of spherical mirrors. – Evaluate images formed by curved mirrors. – Discuss applications of curved mirrors. – Solve problem related to curved mirrors.	– Appreciate the applications of reflection of light in curved mirrors. – Adapt scientific and critical thinking in performing experiments of curved mirrors. – Recognize the applications of plane-curved mirrors.	– Reflection of light at plane and curved reflecting surfaces. – Laws of reflection. – Terms used in curved mirrors (principal axis, principal focus, centre of curvature and other related terms). – Spherical mirrors (concave and convex). – Images in spherical mirrors. – $\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$ and $m=\frac{v}{u}$ – Applications of spherical/curved mirrors. – Locate images formed by curved mirrors by construction of ray diagrams.	– Perform an experiment to verify laws of reflection for plane mirrors – Perform an experiment to determine the focal length of spherical mirrors. – Discuss images formed by curved/spherical mirrors. – Work in groups make presentations on applications of curved mirrors. – Design a project that investigates on the applications of reflection of light in curved mirrors. – Use internet and computer simulations illustrate reflection at plane and curved surfaces. – Solve problems requiring mirror and magnification formulae.

Links to other subjects: *Chemistry (metals, polymers, atomic structure), Motor Industry (Driving mirror), Medicine (Density mirror) Astronomy (reflecting telescope).*
Assessment criteria: *Learner can verify laws of reflection; describe images formed by spherical mirrors and to determine focal length of spherical mirrors. Design a project to investigate applications of reflection of light.*
Materials: *Curved mirrors, spoon, light source, concave, convex mirror, optical pins and small movable screen.*

TOPIC AREA: ELECTRONICS	SUB-TOPIC AREA: ELECTRONIC DEVICES	
S2 PHYSICS	**Unit 15:** Basic electronic components	**Nº of periods: 9**
Key unit competence: by the end of this unit the learner should be able to explain the working principle of basic electronic devices.		

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Define an electronic device. – Name symbols of electronic components. – Identify different electronic component. – Outline the working principle of basic electronic devices.	– Identify electronic components on an electronic motherboard. – Describe electronic component of a motherboard. – Suggest possible importance of electronic devices in everyday life.	– Appreciate important role of electronic devices in life. – Show the concern of electronics in various technological systems. – Appreciate the need to use semiconductor devices in electronics devices. – Acquire knowledge in analysing and modeling physical processes.	– Definition of electronics. – Illustration of Standard symbols of some electronic components (Inductors, Resistors, Capacitors, Ordinary Diodes, Zener diode, Transistors). – Electronic components on a motherboard. – Electronic components: Ordinary Diodes (definition, forwarding and reverse biasing, rectification), Zener diode (voltage regulator), Transistors (amplification of current). – Constituent of a motherboard of electronic devices. – Example of electronic devices (mobile phone, computers, watches).	– Observe different electronic components on an electronic motherboard. – Use computer simulations to demonstrate the operational principles of electronic devices. – Discuss in groups about importance of electronic devices in everyday life. – Suggest some electronic devices with different electronic components. – Use Internet to search to on working principle of basic electronic devices.

			– Working principle of basic electronic devices.	
Links to other subjects: *Computer simulations (ICT), Semiconductor (chemistry).*				
Assessment criteria: *Can explain clearly the explain the working principle of basic semiconductor devices.* *Use computer simulations to demonstrate the operational principle of electronic devices.*				
Materials: *Inductors, Resistors, Capacitors, Ordinary Diodes Zener diode, Transistors.*				

5.4. Senior Three

5.4.1 General objectives for senior three

- Evaluate thermal effects.
- Examine the principle of heat exchange.
- State and explain laws of thermodynamics.
- Apply principle of electromagnetic induction.
- Perform calculations involving electric field intensity.
- Design a simple house electric installation.
- Design simple alternating current circuits.
- Distinguish electronics channels of communication.
- Identify properties physical processes affecting plant growth.
- Explain environmental phenomena using laws of physics.

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: MOTION	
S3 Physics	**Unit 1:** Graphs of linear motion	**Nº of periods: 8**

Key Unit Competence: By the end of this unit the learner should be able to plot and analyse the graphs of linear motion

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Describe graphs of uniform rectilinear motion. – Plot distance - time graph and velocity- time graph. – Identify uniform velocity and non-uniform velocity from displacement-time graphs. – Identify uniform acceleration and non-uniform acceleration from velocity–time graphs. – Explain why the slope of a distance-time	– Appreciate use suitable scale in plot graphs. – Recognise that the area under velocity-time graph represents distance covered by the body. – Determine the speed of body from a distance time graph – Interpret velocity time graph.	– Appreciate that the slope of distance -time graph gives velocity while the slope of velocity-time graph gives acceleration. – Appreciate that linear motion can be represented using graphs.	– Illustration of displacement-time graphs and Velocity-time graphs. – Determine distance covered from a velocity time graph. – Interpretation of distance /displacement and speed/velocity -time graphs.	– Discuss in groups and present suitable scales for plotting graphs. – Interpret linear motion graphs – Discuss determination of distance from velocity- time graph. – Find acceleration from velocity –time graph. – Use Internet and simulations to illustrate graphs of linear motion.

graph gives speed.				
Links to other subjects: *Mathematics and economics (graphs).*				
Assessment criteria: *learner can plot and explain clearly the relationship between distance, velocity acceleration and time and can analyse and provide accurate physical interpretation of distance , velocity acceleration and time graphs.*				
Materials: *rulers, stopwatch and ticker timer.*				

TOPIC AREA: MECHANICS	SUB-TOPIC AREA: FORCE	
S3 PHYSICS	**Unit 2:** Friction force and Newton's laws of motion	**Nº of periods: 10**

Key Unit Competence: By the end of this unit learner should be able to perform experiments involving Newton's laws of motion and friction force.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain inertia – Outline and explain factors affecting inertia. – State and explain Newton's laws of motion. – Describe why objects resist changes. – Describe linear momentum and its conservation. – Describe motion of objects on a horizontal plane with or without friction.	– Design experiments to illustrate Newton's laws of motion. – Investigate effects friction force on motion. – Apply Newton's laws principles in solving motion problem.	– Appreciate the effect of friction force on moving body. – Realize the effect of air resistance on the speed of moving objects. – Appreciate the importance of Newton's laws of motion in life. – Appreciate the protection of persons by safety belt in moving car.	– Review on Newton's laws of motion. – Definition of Linear Momentum. – Distinction between Impulse and linear momentum. – Conservation of linear momentum. – Determination of coefficient of friction.	– Discuss in groups and make presentation on the role of safety belts in car. – Perform an experiment to illustrate momentum change and report. – Perform an experiment and report on the Newton's law of motion and friction force. – Devise an experiment to determine the coefficient of friction and report. – Solve in groups problems related to Newton's laws and on change of momentum. – Use Internet and simulations to demonstrate Newton's laws of motion.

Links to other subjects: *Mathematics (computations, graphs).*

Assessment criteria: *Learner can perform experiments on Newton's laws of motion and friction force.*

Materials: *spring balance, mass, table or wood surface.*

TOPIC AREA: MECHANICS	**SUB-TOPIC AREA: PRESSURE**	
S3 PHYSICS	**Unit 3**: Applications of atmospheric pressure	**Nº of periods: 10**

Key unit competence: By the end of the unit the learner should be able to explain the existence of pressure in gas and the application of atmospheric pressure.

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain the existence of force exerted by air on a surface. – Explain the relationship between atmospheric pressure and altitude. – Relate atmospheric pressure, density of air and altitude. – Outline the applications of atmospheric pressure.	– Explain the force atmospheric pressure exerts on earth surface. – Discuss factors affecting atmospheric pressure. – Explain applications of atmospheric pressure life. – Evaluate factors influencing atmospheric pressure. – .	– Appreciate existence of atmospheric pressure. – Predict change in weather by observing changes in atmospheric pressure. – Be aware of effects of changing of atmospheric pressure on human body as the altitude increases (climbing mountains).	– Illustrating the existence of atmospheric pressure. – Factors influencing the atmospheric pressure. – Relationship between atmospheric pressure and altitude. – Instruments for measuring atmospheric pressure. – Applications of atmospheric pressure – (Drinking straw, rubber sucker, siphon, vacuum cleaner, lift pump, syringe).	– Working in groups to conduct experiments illustrating the existence of forces exerted by air on a surface and make presentation. – In groups discuss factors influencing atmospheric pressure and presenting the findings. – Work in groups to measure the atmospheric pressure using a mercury barometer and make presentation. – Search Internet for applications of atmospheric pressure.

Links to other subjects: *Geography (weather forecast, tides) Aviation Industry (cabin pressurization).*

Assessment criteria: *learner can explain clearly the existence of pressure in gas and the application of atmospheric pressure.*

Materials: *Magdeburg hemispheres, glass tube, aneroid and mercury barometer, mercury, siphon, bicycle pump, Lift pump, rubber suckers.*

TOPIC AREA: MECHANICS	**SUB-TOPIC AREA: ENERGY, WORK AND POWER**	
S3 PHYSICS	**Unit 4:** Renewable and non-renewable energy sources	**Nº of periods:** 10
Key unit Competence: By the end of the unit the learner should be able to differentiate between renewable and non-renewable energy sources and give examples.		

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Outline renewable and non-renewable energy sources. – Describe basic features of renewable and non renewable energy sources.	– Compare energy sources in Rwanda and the rest of world. – Classify energy sources as renewable and non-renewable energy sources. – Estimate the rate of fuel consumption in power stations. – Analyze transformation of energy into different forms.	– Recognize sources associated with carbon dioxide emission. – Appreciate that in most instances, the sun is the prime energy source for world energy. – Appreciate higher rate of energy consumption in developed countries is from large deposits of fossil fuels. – Be aware of the moral and ethical issues associated with nuclear weapons. – Adapt scientific method of thinking – Recognize the need of acquiring knowledge for analyzing and modeling physical	– Energy sources (renewable and non-renewable). – Classification of energy sources in Rwanda and the World: Renewable and non-renewable energy sources (Fossil and non fossil fuels for power production, solar power (photovoltaic cell and solar panel), Hydroelectric power, wind power and wave power). – Transformation of energy (potential energy to kinetic energy and vice-versa). – Electrical to mechanical and vice versa etc.	– Discuss in groups and make presentation on the energy sources in Rwanda and relate to the world. – Discuss in groups and make presentation on difference between renewable and non-renewable energy. – Discuss and make presentation energy transformation power generation plants. – Visit some power generation plants and make a report. – Search internet for other sources of energy

		processes.		
Links to other subjects: *Geography (graphs, photograph interpretations), agriculture (Environment).*				
Assessment criteria: *Can differentiate renewable and non-renewable energy sources and give examples in Rwanda and relate them rest of the world.*				
Materials*: Simulations, typical scientific reports.*				

TOPIC AREA: THERMAL PHYSICS		
S3 PHYSICS	**Unit 5:** Heat transfer and quantity	**Nº of periods: 9**

Key unit competence: By the end of the unit the learner should be able to evaluate modes of heat transfer and determine specific heat capacity of metal block.

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Recall the differences between heat and temperature. – Explain modes of heat transfer. – Explain thermal expansion of solids. – Explain applications of heat exchanges. – Explain thermal expansions. – Define the terms heat capacity and specific heat capacity. – Describe experiments to determine specific capacity of a metal.	– Apply knowledge of heat capacity to predict the behaviour of different materials as temperature is changed. – Describe different modes of heat exchange. – Calculate heat capacity, specific heat capacity, Latent heat, specific latent heat – Carry out an investigation that illustrates heat exchange. – Analyse experiments on thermal expansion of solids. – Differentiate linear	– Appreciate application of modes of heat transfer. – Acquire knowledge in analyzing the behaviour of materials under thermal expansion. – Be aware of difficulties related to heat exchanges.	– Difference between heat and temperature. – Modes of heat transfer: radiation, convection and conduction. – Applications of heat transfer modes. – Thermal expansion: linear, surface and volume expansion. Latent heat. – Heat capacity and specific heat capacity, Specific latent heat specific latent of vaporization and fusion. – Experiment to determine specific heat capacity a metal block.	– Perform an experiment to determine specific heat capacity and present the findings. – Demonstrate modes of heat transfer – Perform an experiment on thermal expansion of given solid objects and report. – Perform experiments to illustrate heat transfer by conduction, convection and radiation and report. – Carry out an investigation that illustrates heat exchange – Solve problems related to expansion and heat capacity – Search Internet for applications of heat transfer and make presentation.

– Determine coefficient of expansion.	surface and volume expansion of different object.			
Links to other subjects: *Chemistry (chemical reactions), Geography (solar radiation, wind, weather forecast sea breezes).*				
Assessment criteria: *The learner can evaluate thermal effects and explain clearly principle of heat exchanges.*				
Materials*: Water, copper, iron/metal block, thermometer, ruler calorimeters.*				

TOPIC AREA: THERMODYNAMICS				
S3 PHYSICS	**Unit 6:** Laws of thermodynamics			**Nº of periods: 9**
Key unit competence: By the end of this unit the learner should be able to describe the internal energy of a system by applying laws of thermodynamics.				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– State the laws of thermodynamics. – Describe application of thermodynamics laws. – Explain the functioning of the refrigerator. – Describe heat exchanges. – Explain the work done on a system when heat energy increases or reduced.	– Show how heat energy is increase with an increase of external work done. – Determine the quantity of heat using the method of mixture. – Demonstrate the change of state as a result of internal energy. – Carry out an investigation on how one state is transformed into another state. – Differentiate internal energy and external energy as an increase in energy due to work done on a system.	– Appreciate the importance of internal energy in increasing the temperature of a body. – Be aware of the rate at which bodies loose energy. – Adapt scientific method of thinking – Recognize the need of acquiring knowledge of analyzing and modelling physical processes using laws of thermodynamics.	– The first and second laws of thermodynamics. – Application of the principle of thermodynamics: Refrigerator functioning, melting and solidifying. – The principle of heat exchange. – The kinetic theory of matter.	– Demonstrate work done on system using boiling water and report. – Discuss in groups and present freezing water and melting of ice. – Carry out investigations and write report on melting and freezing. – Search Internet for internal energy and laws of thermodynamics.

Links to other subjects: *Mathematics (graphs), Chemistry (properties of matter).*
Assessment criteria: *learner can conduct and report an experimental work on melting and freezing and evaluate the internal energy of a system by applying laws of thermodynamics.*
Materials: *Bunsen burner, or electric heater, refrigerator, ice, water, source pan.*

TOPIC AREA: ELECTRICITY	SUB-TOPIC AREA: ELECTROMAGNETIC INDUCTION	
S3 PHYSICS	**Unit 7:** Introduction to electromagnetic induction	**Nº of periods: 9**
Key unit competence: By the end of this unit the learner should be able to apply the principle of electromagnetic induction.		

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– State the Laws of electromagnetic induction. – Recall the expression of induced EMF. – Explain electromagnetic induction. – Define the term alternating current. – Explain EMF induced in a coil rotating in uniform magnetic field. – Explain the functioning of alternating current generator. – Explain the variation of induced EMF with change of generator	– Explain the expression of induced EMF in a straight conductor moving in magnetic field. – Analyse induced EMF in a changing magnetic flux. – Analyse applications of alternating current. – Deduce an expression for induced EMF for a coil rotating in uniform magnetic field. – Explain operation of basic alternating current generator. – Evaluate variation in induced emf	– Appreciate the application of electromagnetic induction. – Adapt or acquire scientific techniques, reasoning and attitudes for analyzing theories and expressions. – Show the concern of possible risks involved in living and working near high-voltage power lines.	– Laws of electromagnetic induction. – Induced electromotive force. – Formula for the emf induced in a straight conductor moving in magnetic field. – Production of an induced emf by a time changing magnetic flux. – Alternating current – Induced EMF in a coil rotating within uniform magnetic field. – Operation alternating current generator. – Effect on the induced EMF by changing the generator frequency. – Relation between peak and RMS values for sinusoidal currents and voltages. – Problems involving peak and RMS values.	– Establish the expression of emf induced in a straight conductor moving in magnetic field. – Solve problems of electromagnetic induction. – Derive an expression of induced EMF in a coil rotating in uniform magnetic field. – Discuss effect on induced emf when the generator frequency changes. – Relate peak and RMS values for sinusoidal currents and voltages. – Solve problems involving peak and rms values. – Discuss the operation of an ideal transformer. – Search internet for information on electromagnetic induction.

frequency. – Explain the functioning of a transformer – Relate peak and RMS values	when generator frequency changes – Relate peak and RMS values for sinusoidal currents and voltages.			
Links to other subjects:				
Assessment criteria: *learner can apply the principle of electromagnetic induction and solve problems on peak and RMS values.*				
Materials: *Source of voltage, conductor, magnets, transformer, wire, and switch, galvanometer.*				

TOPIC AREA: ELECTRICITY	SUB-TOPIC AREA: ELECTROMAGNETIC INDUCTION	
S3 PHYSICS	**Unit 8:** Electrical power transmission	**Nº of periods: 10**
Key unit competence: By the end of the unit the learner should be able to analyse the transmission of electrical power		

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain the use of high-voltage step-up and down transformers and power transmission. – Describe the transmission of electrical power. – Outline the reasons for power losses in transmission lines and real transformers. – Explain the step-up and down transformers and power transmission. – State dangers of staying near high-voltage power lines.	– Analyse the operation of an ideal transformer. – Describe a transformer. – Explain the operation of an ideal transformer. – Analyse the transmission of electrical power. – Discover reasons for power losses in transmission lines and real transformers. – Show possible risks involved in living and working near high- voltage power lines.	– Appreciate the applications of electromagnetic induction. – Acquire scientific techniques, reasoning and attitudes in analyzing theories and expressions. – Realize reasons for power losses in transmission lines and transformers. – Develop scientific skills for analysing functioning of ideal transformers. – Discover other reasons for power losses in transmission lines and real	– Operation of an ideal transformer. – Transmission of electrical power. – Power losses in transmission lines and real transformers. – Step-up and down transformers and power transmission. – Solve problems on transformers and power transmission. – Dangers high- voltage power lines.	– In groups discuss the functioning and role of a transformer and write report. – Discuss power losses in transmission lines and real transformers. – Solve problems on ideal transformers. – Discuss dangers living and working near high- voltage power lines. – Search Internet for details on transmission of electrical power.

		transformers. – Show the concern of high-voltage step-up and down transformers and power transmission. – Realize dangers associate with living and working near high- voltage power lines.		
Links to other subjects: *Atoms and metals (chemistry).*				
Assessment criteria: *Learner can discuss the operation of an ideal transformer and possible risks involved in living and working near high- voltage power lines.*				
Materials: *source of voltage, conductor, magnets, transformer, connecting wires, and switch.*				

TOPIC AREA: ELECTRICITY	SUB-TOPIC AREA: ELECTROSTATICS	
S3 PHYSICS	**Unit 9:** Electric field intensity	**Nº of periods: 9**

Key unit competence: By the end this unit the learner should be able to calculate intensity of electric field due to one or more point charges

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Illustrate electric field patterns due to two charges. – State the principle of superposition for point charges in an electric field. – Describe field patterns for two point charges. – Explain the intensity of electrical field to the position of charge. – Explain electric field intensity at different point due to a charge – Explain superposition of parallel electric fields.	– Describe the electric field patterns due to like charges, and unlike charges. – Relate the intensity of electric field to the position of charge. – Differentiate electric force and electric field. – Compare the electric field intensity at different points – Determine the electric field intensity due to one or more than point charges.	– Appreciate the applications of electrostatic force. – Show concern about dangers of electric field and how to minimize hazards. – Acquire ability to think logically and systematically as you pursue a particular line of thoughts. – Adapt scientific method of thinking applicable in all areas of life. – Acquire knowledge for analysing and modelling physical processes.	– Electrostatic force and Coulomb's force. – Superposition of parallel electrostatic forces. – Definition of electric field. – Electric field lines. – Electric field due to one point charge. – Superposition of parallel electric fields.	– Discuss in groups electric field lines for a point charge. – Discuss in groups, electric field lines for two like charges. – Discuss in groups electric field lines for two unlike charges. – Perform an experiment on electric field between two parallel charged plates. – Solve problems related to electric field intensity

Links to other subjects: *Chemistry (structure of an atom)*

***Assessment criteria: Learner can e**xplain what happens when a material being rubbed with a cloth charges negatively or positively. Differentiate good insulators and good conductors.*

***Materials:** pens and combs made of plastics, scraps of paper, polythene rod and cloths.*

Topic Area: ELECTRICITY	**Sub-topic: DIRECT CURRENT**	
S3 PHYSICS	**Unit 10:** House electric installation	**Nº of periods:** 12

Key unit competence: By the end of the unit the learner should be able to analyse and carry out a simple electric installation.

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Describe the electric diagrams. – Differentiate between surface wiring and conduit wiring. – Identify components used in electrical installation. – Explain protecting electric devices and their installation. – Identify different lamps.	– Describe symbols used in electrical engineering drawing. – Describe the cable by type and size used for lightning arrestor, lighting and socket outlets. – Carry out simple surface wiring for a residential house using appropriate tools. – Evaluate different electrical protective devices. – Explain the functioning of circuit breakers and fuses in electrical circuits.	– Appreciate applications of electricity. – Develop responsible behavior towards electrical installation. – Develop responsible behaviour for protection against dangers associated with electricity. – Acquire skills for identifying problems in electric circuits.	– Standard symbols for electrical installation. – Symbols on circuit diagrams. – Types of electrical cables and their sizes – Function of circuit breakers and fuses. – Fuse rating. – Installation of lightening arrestor. – Incandescent lamp, tungsten lamp, gas filled lamps. – Transmission of electricity. – Dangers of electricity. – Installation of earth wire.	– Discuss in a group symbols used in electrical installation diagrams. – Discuss in a group, the types of electrical cables and their standard sizes. – Discuss in a group safety measures in domestic electrical installation. – Use role-play to explain the connection between physics, technology and society. – Devise an experiment using a domestic electrical installation. – Use a group presentation to analyse applications of physics and technology.

Links to other subjects: *Blood circulation (Biology) and Laboratory safety rules (chemistry).*

Assessment criteria: *learner can carry out a simple domestic electrical installation and explain theories involved.*

Materials*: voltage supply, wires/cables, main fuse, switches, lamp sockets, wall socket, lightning arrestor.*

TOPIC AREA: ELECTRICITY	SUB-TOPIC: ALTERNATING CURRENT	
S3 PHYSICS	**Unit 11:** Basic alternating current circuits.	**Nº of periods:** 12

Key unit competence: By the end of the unit the learner should be able to design and analyse simple alternating current circuits.

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Identify circuit symbols representing electrical components. – Describe design of electrical circuits using different electrical components. – Design an electric circuit consisting of AC voltage and inductor, resistor and capacitor. – Describe the function of inductor in an electric circuit.	– Identify and apply electrical components in AC circuits – Differentiate between an alternating current and a direct current. – Explain function of inductor, resistor and capacitor in electric circuits. – Manipulate apparatus and equipment, given procedures, to obtain data. – Evaluate and draw conclusion using experimental results.	– Appreciate applications of electric circuits. – Be aware of the safety precaution to be observed while handling electrical circuits. – Appreciate advantage of A.C. over D.C.	– Standard symbols used in electric circuit and their functions. – A.C. connected to a single resistor. – ac source connected to a single capacitor. – ac voltage connected to a single inductor. – The RLC series circuit.	– Working in groups – Design a circuit diagram with one of these components: Resistor, Inductor or Capacitor and observe different phenomena based on it.

Links to other subjects: *(Biology, and Chemistry) Laboratory procedures and safety rules.*

Assessment criteria: *Learner can accurately identify electrical circuit symbols, design, connect components and analysis simple alternating current (A.C.) circuit.*

Materials: *Resistors, capacitors, inductors, coils, A.C. and D.C. sources.*

TOPIC AREA: LIGHT		
S3 PHYSICS	**UNIT 12:** Refraction of light	**Nº of periods: 9**
Key Topic Competence: By the end the end of the learner should be able to explain refraction of light phenomenon		

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Recall the propagation of light and reflection. – Explain phenomenon of refraction of light. – State the laws of refraction of light. – Explain total internal reflection of light and its application. – Explain how spherical thin lenses form images. – Explain defects of lenses and how they occur.	– Analyse graphical construction of images formed by converging or diverging thin lens. – Evaluate the correction of defects in lenses. – Describe types of light refraction. – Analyse the dispersion of light by glass prism. – Measure refractive index.	– Appreciate the formation of real and virtual image by lenses. – Appreciate the applications thin lenses. – Appreciate different colours in white light. – Internalize the formation of a rainbow. – Appreciate the bending of light when it moves from one medium to another.	– Bending of light between adjacent media. – Verification of Snell's law. – Refractive Index. – Refraction of light through layers of parallel media. – Total internal reflection of light. – Applications of total internal reflection e.g. optic fibre. – Refraction of light through a thin lens (converging and diverging thin lens). – Location of images formed by thin lenses using ray diagram method – Lens formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ and	– Demonstrate refraction of light using air-water and air-glass block. – Establish experimentally the laws of refraction of light. – Measure refractive index of a glass block. – Using ray diagrams locate image position formed by thin lenses. – Describe a glass prism and measure its refractive index. – Illustrate total internal reflection of light using a right-angled prism. – Demonstrate dispersion of light using a prism. – Use Internet and computer

– Describe the spectrum of light by glass prism. – Outline different applications of refraction of light.			$m = \frac{v}{u}$ – Power of lens $P = \frac{1}{f}$ and for two lens in contact. $P = P_1 + P_2$ – Lens defects (chromatic and spherical aberration) and their corrections. – Explanation of refraction of light through a glass prism. – Dispersion of light by a glass prism. – Problem solving on refraction of light	simulations to illustrate refraction of light and its applications.
Links to other subjects: *Biology (study of cell), Medicine (in microscope,) Tourism (use of binoculars to watch wild animals).*				
Assessment criteria: *Learner can identify and explain clearly the properties of images formed by thin lens.*				
Materials: *Water, glass block, glass prism, thin lenses and sheets of paper telescopes, spectacles, microscope.*				

TOPIC AREA: ELECTRONICS	Sub-TOPIC Area: Telecommunication	
S3 PHYSICS	Unit 13: Telecommunication Channels	Nº of periods: 9

Key Unit Competence By the end of this unit the learner should be able to differentiate telecommunication channels.

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Recall refraction of light and total internal reflection. – Define and explain the term communication. – Outline different channels of communication. – Distinguish between digital and analogue signals. – Explain difficulties related to signal transmission. – Outline difficulties experienced in communication system. – Describe simple	– Apply knowledge acquired to characterize quality of a communication system. – Use computer simulations to demonstrate channels of communication. – Suggest different channels of communication applied in telecommunication. – Evaluate difficulties experienced in communication system.	– Appreciate applications of communication – Adapt scientific techniques in analysing and modelling simple block diagram of communication systems. – Acquire ability to deal with difficulties related to signal transmission.	– Definition of communication. – Digital and analog signals. – Types of communication channels (wire pairs, coaxial cables, optic fibre, radio waves and satellite communication). – Advantages and disadvantages of : wire pairs, coaxial cables, optic fibre , radio waves and satellite communication). – Simple block diagram of communication system.	– Research scientific journals for telecommunication institutions and make report. – Use computer simulations to demonstrate communication channels. – Suggest other different channels of communication used in telecommunication. – Discuss advantages and disadvantages of optic fibre, telephone and radio waves as channels of communication. – Search Internet to more information about channels of communication and report.

block diagram of communication system.			– Application.	
Links to other subjects: *Aviation (radar, telefax), Military, Computer simulations (ICT).*				
Assessment criteria: *Learner can outline different channels of electronic telecommunication involving electronics devices.*				
Materials*: mobile phone, receiver, emitter, radio receiver.*				

TOPIC AREA: ENVIRONMENTAL PHYSICS		SUB-TOPIC AREA: ENVIRONMENTAL FACTORS		
S3 PHYSICS	**Unit 14:** Properties of Physical processes affecting plant growth.			**Nº of periods:** 9
Key unit Competence: By the end this unit the learner should be able to describe the physical properties affecting plant growth.				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Explain environment factors. – Explain composition of the atmosphere, soil aeration and soil structure, soil reaction, – Explain Biotic factors, and mineral supply. – Describe impact of environmental factors on range plant productivity water, temperature, light, atmosphere, nutrients, fire and grazers. – Describe physical properties of soil (soil structure and texture) and their	– Explain aspects of physics in physical processes affecting the environment. – Apply knowledge of physics to explain factors affecting plant growth. – Identify physical properties of soil (soil structure and texture) and describe their relation to plant nutrition and plant growth.	– Appreciate the need to think scientifically, and evaluate environmental factors that affects plant growth. – Appreciate the benefits of mineral elements (cobalt, vanadium, sodium, silicon, selenium) to plants. – Adapting scientific method of reasoning about the environment.	– Environmental factors: Temperature, Moisture supply, Radiant energy, – Composition of the atmosphere, Soil aeration and soil structure, Soil reaction. – Biotic factors, Supply of mineral nutrients. – The impact environmental factors on range plant productivity, on water, temperature, light, atmosphere, nutrients, fire and grazers. – Physical properties of soil (soil structure and texture) in relation to plant nutrition and plant growth.	– Discuss in groups and make presentation on environmental factors: Temperature, moisture supply, radiant energy, composition of the atmosphere, soil aeration and soil structure, soil reaction, biotic factors, supply of mineral nutrients. – Discuss in groups and make debate on the impact of selected environmental factors on range plant productivity: water, temperature, light, atmosphere, nutrients, fire and grazers. – Discuss in groups and make presentation on physical properties of soil (soil structure and texture) and their role in plant nutrition

application on plant nutrition and plant growth.				and plant growth. – Search Internet literature on environment protection.
Links to other subjects: *Data gathering, graphs in maths, photographic interpretations in Geography, agriculture (plant growth), plants in Biology.*				
Assessment criteria: learner can *explain clearly the physical properties and factors affecting plant production.*				
Materials: *Plants, Environment, Thermometers*				

TOPIC AREA: ENVIRONMENTAL PHYSICS	**SUB-TOPIC AREA: ENVIRONMENTAL FACTORS**	
S3 PHYSICS	**Unit 15:** Environmental phenomena and related physics concepts	**Nº of periods:** 9
Key unit Competence: By the end of this unit the learner should be able to relate physics concepts with environmental phenomena.		

Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
– Recall modes of heat transfer. – Describe the basic thermodynamics and relate to the environment. – Describe the basic composition, structure and dynamics of the atmosphere. – Explain principle of hydrologic cycle and the mechanisms of water transport in the atmosphere and the ground. – Outline environmental problems such as noise pollution,	– Apply the basic thermodynamics to environment. – Explain basic composition, structure and dynamics of the atmosphere. – Evaluate the principle of hydrologic cycle as mechanisms for water transport in the atmosphere and the ground. – Carryout investigation on environmental problems such as noise pollution, ozone depletion and global warming in	– Appreciate that all environmental processes are interdependent. – Appreciate applications of principles and laws of physics environments issues. – Appreciate the need to think scientifically about the environment – Recognize the value of adapting scientific method in analyzing the environment – Appreciate applications of Physics principles and laws in environmental laws. – Be aware of human	– Environment and energy transfers (first and second law of thermodynamics). – Noise pollution, air pollution. – Climate change science: structure and composition of the atmosphere. – Ozone layer and the atmosphere, Greenhouse effect. – Global warming. Hydrosphere and hydrologic cycle. – Water, atmosphere and clouds. – Cyclones and anticyclones. – Global convection currents and wind patterns. – Warming of the earth surface Thermoregulation and Physics laws governing it. – Thermodynamics Laws (principles of entropy, enthalpy, Gibbs free energy	– Discuss and make presentations on the principle of hydrologic cycle , mechanisms of water transportation in the atmosphere and the ground. – Discuss in groups environmental problems such as noise pollution, ozone depletion and global warming. – Search Internet for details on relationship between environment and physics.

ozone depletion and global warming.	the context of a dynamics atmosphere.	activities that affect environment.	law, principles of conduction, convection, radiation and evaporation, Newton's law of cooling).	
Links to other subjects: *Data gathering/statistics, graphs in Mathematics, photographic interpretations in Geography, environment and Agriculture, plants in Biology.*				
Assessment criteria: *explain clearly laws and concepts of physics applied in environmental science*				
Materials: *Environment, atmosphere, plants*				

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7.APPENDIX

Subjects and weekly time allocation for ordinary level

Core subjects	**Weight (%)**	**Number of Periods (1 period = 40 min.)**		
		S1	S2	S3
1. English	11	5	5	5
2. Kinyarwanda	7	3	3	3
3. Mathematics	13	6	6	6
4. Physics	9	4	4	4
5. Chemistry	9	4	4	4
6. Biology and Health Sciences	9	4	4	4
7. ICT	4	2	2	2
8. History and Citizenship	7	3	3	3
9. Geography and Environment	7	3	3	3
10. Entrepreneurship	4	2	2	2
11. French	4	2	2	2
12. Kiswahili	4	2	2	2
13. Literature in English	2	1	1	1
Sub Total		**41 periods**	**41 periods**	**41 periods**
II. Elective subjects: Schools can choose 1 subject				
Religion and Ethics	4	2	2	2
Music, Dance and Drama	4	2	2	2

Fine arts and Crafts	4	2	2	2
Home Sciences	4	2	2	2
Farming (Agriculture and Animal husbandry)	4	2	2	2
III. Co-curricular activities (Compulsory)				
Physical Education and Sports	2	1	1	1
Library and Clubs	2	1	1	1
Total number of periods per week	**100**	**45**	**45**	**45**
Total number of contact hours per week		**30**	**30**	**30**
Total number of hours per year (39 weeks)		**1170**	**1170**	**1170**