



Republic of Zambia

MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL, TRAINING AND EARLY EDUCATION

PHYSICS SYLLABUS

GRADES 10 – 12



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VISION

Quality, life-long education for all which is accessible, inclusive and relevant to individual, national and global needs and value systems.

PREFACE

The syllabus was produced as a result of the Curriculum review process carried out by the Ministry of Education, Science, Vocational Training and Early Education under the auspices of the Curriculum Development Centre (CDC). The curriculum reform process started way back in 1999 when the Ministry of Education commissioned five (5) curriculum studies which were conducted by the University of Zambia. These studies were followed by a review of the lower and middle basic and primary teacher education curriculum. In 2005 the upper basic education National survey was conducted and information from learners, parents, teachers, school managers, educational administrators, tertiary institutions traditional leader's civic leaders and various stakeholders in education was collected to help design a relevant curriculum.

The recommendations provided by various stakeholders during the Upper Basic Education National survey of 2005 and National symposium on curriculum held in June 2009 guided the review process.

The review was necessitated by the need to provide an education system that would not only incorporate latest social, economic, technological and political developments but also equip learners with vital knowledge, skills and values that are necessary to contribute to the attainment of Vision 2030.

The syllabus has been reviewed in line with the Outcome Based Education principles which seek to link education to real life experiences that give learners skills to access, criticize analyze and practically apply knowledge that help them gain life skills. Its competences and general outcomes are the expected outcomes to be attained by the learners through the acquisition of knowledge, skills, techniques and values which are very important for the total development of the individual and the nation as a whole.

Effective implementation of Outcome Based Education requires that the following principles be observed: clarity of focus, Reflective designing, setting high expectations for all learners and appropriate opportunities.

It is my sincere hope that this Outcome Based syllabus will greatly improve the quality of education provided at Grade 8 and 9 as defined and recommended in various policy documents including Educating Our Future`1996 and the `Zambia Education Curriculum Framework `2013.

Chishimba Nkocha
Permanent Secretary

MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL, TRAINING AND EARLY EDUCATION.

Acknowledgements

The syllabus presented here is a result of broad-based consultation involving several stakeholders within and outside the education system.

Many individuals, institutions and organizations were consulted to gather their views on the existing syllabus and to accord them an opportunity to make suggestions for the new syllabus. The Ministry of Education wishes to express heartfelt gratitude to all those who participated for their valuable contributions, which resulted in the development of this syllabus.

The Curriculum Development Centre worked closely with other sister departments and institutions to create this document. We sincerely thank the Directorate of Teacher Education and Specialized Services, the Directorate of Planning and Information, the Directorate of Human Resource and Administration, the Directorate of Open and Distance Education ,the Examinations Council of Zambia, the University of Zambia, schools and other institutions too numerous to mention, for their steadfast support.

We pay special tribute to co-operating partners especially JICA and UNICEF for rendering financial technical support in the production of the syllabus.

C.N.M Sakala (Mrs.)

Director-Standard and Curriculum

MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL TRAINING AND EARLY EDUCATION

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Sakala C. N.M (Mrs.)

Director, Standards and Curriculum

MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL TRAINING AND EARLY EDUCATION

INTRODUCTION

This syllabus has taken into consideration relevant aspects of the 1996 National Policy on Education entitled “Educating Our Future”, which demands that the education system should aim at producing a learner capable of appreciating the relationship between scientific thought, action and technology on the one hand, and sustenance of the quality of life on the other. Furthermore, it is part of the policy of the Ministry of Education to improve the teaching and learning of Mathematics and Science in High School.

Another major aspect of this syllabus is that it has taken into consideration environmental issues with emphasis on application of Physics in everyday life.

The syllabus takes into account the fact that the pupils who will follow it will be of different background. Some will study further Physics; some will require the knowledge of this background Physics in pursuing other scientific studies, while some will join the world of work.

GENERAL AIMS OF THE SYLLABUS

The Syllabus aims at contributing to pupils’ general education by using the impact of well-known applications of physics concepts and principles on society. This approach is intended to stimulate pupils’ curiosity and sense of enquiry which will in turn not only provide a suitable basis for further study of the subject, but also provide pupils with sufficient knowledge and understanding to make them become useful and confident citizens. The essence of such an enquiry is related to problem solving. This further aims at developing the skills necessary to find solutions to scientific problems.

During this course pupils should acquire the following:

1. Knowledge and understanding of facts, ideas techniques and the applications of Physics.
2. Skill in applying their knowledge and understanding in problem solving.
3. Practical abilities associated with investigation of certain phenomena and principles in Physics.
4. Positive Scientific attitudes such as open mindedness and willingness to recognise alternative points of view.

GENERAL STRUCTURE OF THE SYLLABUS

The syllabus is divided into units. Every effort has been made to arrange the topics in a logical order but this is not intended to suggest a teaching order. It is hoped teachers will develop a considerable flexibility in planning their presentations.

Each of the Units is described under the headings of “Content”, “specific outcomes” knowledge, skills and “values”. The column headed “skill” is intended to guide with the type of practical skills to be acquired while value must show what action the learner will take after learning the content and skill and is not to be regarded as exhaustive. The teacher can still extend it by relating the factual contents and specific outcome(s) of the syllabus to social, economic and industrial life at both local and national levels.

In view of the increasing impact of electronics and computers, bipolar transistors and logic gates have been included in the syllabus. It is envisaged that an experimental approach will be adopted and that pupils will spend adequate time on individual experimental work.

MATHEMATICAL REQUIREMENTS

The study of Physics through this syllabus strengthens the applications of mathematical skills. It is assumed the pupils will be computer in the following mathematical techniques:-

1. Taking account of accuracy in numerical work and handling calculations so that significant figures are neither lost unnecessarily nor carried beyond what is justified.
2. Making approximate evaluation of numerical expressions.
3. Formulating simple algebraic equations as mathematical models from physics situations and be able to solve them.
4. Changing the subject of a formula.
5. Expressing small changes or errors as percentages.
6. Calculating areas of various shapes.
7. Dealing with vectors in all simple forms.
8. Plotting results graphically after selecting appropriate variables and scales.
9. Interpreting, analysing and translating graphical information.

NOTE: The list of mathematical abilities above is intended as a guide but is in no way limited nor exhaustive

ASSESSMENT OF OBJECTIVES

The syllabus will stress:

1. Knowledge and understanding in the following:
 - (a) Scientific phenomena, facts, concepts, theories and laws.
 - (b) Scientific terminology, use of symbols, quantities and units.
 - (c) Scientific apparatus and instruments and their safe operation.
 - (d) Scientific and technological applications with social, economic and environmental relevance.

2. Handling information and solving problems including to:
 - (a) locate, select, organise and present information from a variety of sources;
 - (b) translate information from one form to another;
 - (c) manipulate numerical data;
 - (d) identify patterns and draw inferences from information;
 - (e) give reasonable explanations for patterns and relationships;
 - (f) make predictions and hypotheses.

3. Experimental skills including those involving how to:
 - (a) follow instructions;
 - (b) use techniques, apparatus and materials;
 - (c) observe, measure and record;
 - (d) plan investigations;
 - (e) interpret and evaluate observations and results;
 - (f) evaluate methods and suggest possible improvements.

Continuous assessment will be emphasised by using various methods of testing according to topics and themes at various levels. The examinations council of Zambia will prepare detailed procedures on how continuous assessment will be conducted by the teachers. The examination council will also develop examination syllabus to provide teachers with guidelines on the objectives to be tested. The scheme of assessment will consist of school based assessment and final examination that will be conducted by the examinations of council of Zambia.

School based assessment will be in the form of tests. Tests will be in the form of diagnostic, aptitude, achievement, oral, practice attitude and performance, learners.

TIME ALLOCATION

A minimum of six periods of forty minutes each per week, preferably with one (1) double period taken in laboratory for practical work.

Grade 10

<p>General Outcomes:</p> <ul style="list-style-type: none">• Develop an understanding of measurements• Develop investigative skills• Demonstrate an understanding of mechanics	<p>Key competences</p> <ul style="list-style-type: none">• Demonstrate ability to measure length, time, mass, weight and volume• Show skills and knowledge to calculate density, speed, velocity, acceleration and force• Demonstrate ability to use different sources of energy• Demonstrate ability to use simple machines to do work
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TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.1 Measurements	10.1.1 International System of Units (SI).	<p>10.1.1.1 Distinguish between basic and derived quantities</p> <p>10.1.1.2 Identify basic units and derived units.</p> <p>10.1.1.3 Recognise prefixes, multiples and submultiples of fundamental and derived units.</p> <p>10.1.1.4 Use scientific notation and significant figures in numerical problems.</p>	<ul style="list-style-type: none"> • The difference between basic and derived quantities: Basic quantities; mass, length, time etc Derived quantities: force, acceleration, velocity etc • Basic and Derived units: Basic units: metre(m), kilogram(Kg), seconds(S), Kelvin(K) Derived unit: Newton(N), metre per square second(m/s^2) • Fundamental and derived units: Prefixes, multiples and submultiples of basic and derived units • Scientific notation: numbers written using powers of ten and significant figures: important figures 	<ul style="list-style-type: none"> • Comparing basic quantities and derived quantities. • Expressing numbers in scientific notation • Specifying number of significant figures 	<ul style="list-style-type: none"> • Asking questions about physical quantities • Participating in group actively • Applying numbers in standard form

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	10.1.2 Length and time	<p>10.1.2.1 Demonstrate the use of various measuring instruments to determine length</p> <p>10.1.2.2 Demonstrate the use of clocks and devices for measuring an interval of time</p> <p>10.1.2.3 Identify factors that affect the period of a simple pendulum</p>	<ul style="list-style-type: none"> • Use of measuring instruments: such as rules, vernier calipers and micrometer screw gauge to measure the physical quantity of length • Use of devices for measuring time: Using clocks to measure time intervals and period of pendulum • A simple pendulum: Factors affecting the period of pendulum such as length and amplitude 	<ul style="list-style-type: none"> • Measuring lengths of different objects • Measuring an interval of time using clocks • Communicating factors affecting the period of pendulum 	<ul style="list-style-type: none"> • Participating in group actively • Asking questions for more understanding • Applying the use of clocks and devices to determine the period of pendulum
	10.1.3 Mass and, weight	<p>10.1.3.1 Distinguish between mass and weight</p> <p>10.1.3.2 Demonstrate how to measure mass and weight</p> <p>10.1.3.3 Demonstrate how to locate the centre of mass of an object</p> <p>10.1.3.4 Describe qualitatively the effect of the</p>	<ul style="list-style-type: none"> • Differences between mass and weight in terms of units, measuring instrument and quantities • Instruments for measuring mass and weight: Using Triple beam balances and spring balances to measure mass and weight • Locating the center of mass of an object: Use of lamina to locate centre of mass of an object • Stability of objects in terms of the position of the centre of mass e.g. equilibrium (stable ,unstable and 	<ul style="list-style-type: none"> • Comparing mass with weight • Measuring mass and weight of objects • Investigating the centre of mass of objects • Communicating conditions for stability of objects, e.g. base, position of centre of mass 	<ul style="list-style-type: none"> • Asking questions for more understanding • Appreciating the use of beam and spring balances • Participating in group actively in locating the centre of mass

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		position of the centre of mass on the stability of an object.	neutral)		
	10.1.4 Density	10.1.4.1 Determine the density of floating objects 10.1.4.2 Determine the density of a mixture of liquids 10.1.4.3 Describe what relative density is 10.1.4.4 Calculate relative density of air	<ul style="list-style-type: none"> • Density of floating objects: e.g. cork • Density of miscible liquids: e.g. alcohol and water ($\rho = (m_1 + m_2) / (v_1 + v_2)$) • What relative density is: Relative density as ratio without units • Calculation of relative density: Use of formula; Relative density of substance (relative density = density of substance / density of water) 	<ul style="list-style-type: none"> • Calculating the density of a floating object using displacement method • Comparing the densities of other objects 	<ul style="list-style-type: none"> • Participating in a group actively • Asking questions for more understanding

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.2 Mechanics	10.2.1 Scalars and vectors.	<p>10.2.1.1 Describe what scalar and vector quantities are</p> <p>10.2.1.2 Distinguish between scalars and vectors.</p> <p>10.2.1.3 Demonstrate adding of vectors to determine a resultant</p> <p>10.2.1.4 Demonstrate how to determine the resultant of two vectors graphically.</p>	<ul style="list-style-type: none"> • Scalar and Vector quantities: Quantities; Scalar -size and no direction, vectors -size and direction • The difference between scalar and vectors: Scalar (distance, mass , time, speed, length, area, volume, temperature, density, work, energy, power), Vectors (weight, force, acceleration, displacement, velocity, moment) • Resultant of vectors: Adding vectors using the formula $F_R = F_1 + F_2$ and $F_R = F_2 - F_1$ • Resultant of two vectors graphically 	<ul style="list-style-type: none"> • Classifying physical quantities into vectors and scalars • Determining magnitudes of resultant vector • Formulating the resultant of two vectors by graphical methods 	<ul style="list-style-type: none"> • Participating in a group actively • Asking questions for more understanding • Appreciating the use of graphical method when adding vectors
	10.2.2 Linear motion	10.2.2.1 Describe the terms used in mechanics.	<ul style="list-style-type: none"> • Terms used: such as distance, displacement, speed, velocity, acceleration 	<ul style="list-style-type: none"> • Comparing distance with displacement; speed with velocity 	<ul style="list-style-type: none"> • Participating in a group actively • Appreciating the

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		bodies.	retardation)	etc	belts on vehicles
		10.2.3.3 Describe the inertia law	<ul style="list-style-type: none"> • Resistance to change in state of motion (Newton's 1st law) • The relationship between force and acceleration: A constant force produces a constant acceleration • The relationship between mass and acceleration: Increase in mass results in reduction in acceleration (mass is inversely proportional to acceleration for a constant force) 	<ul style="list-style-type: none"> • Investigating the relationship between mass and acceleration, e.g. higher inertia is due to larger mass 	<ul style="list-style-type: none"> • Appreciating Newton's second law of motion • Giving a presentation of group work
		10.2.3.4 Demonstrate the relationship between force and acceleration		<ul style="list-style-type: none"> • Describing the relationship between mass and acceleration 	<ul style="list-style-type: none"> • Knowing the safety rules of investigation
		10.2.3.5 Demonstrate the relationship between mass and acceleration.		<ul style="list-style-type: none"> • Organising the data of investigation in a table 	
		10.2.3.6 Perform calculations on force.	<ul style="list-style-type: none"> • How to calculate force: Using formula; Force = mass × acceleration 	<ul style="list-style-type: none"> • Calculating force, mass and acceleration 	<ul style="list-style-type: none"> • Applying the restoration force in devises
		10.2.3.7 Investigate the effect of force on a spring.	<ul style="list-style-type: none"> • Hooke's law ($F \propto e$) including graphs. 	<ul style="list-style-type: none"> • Communicating the effects of friction 	<ul style="list-style-type: none"> • Participating in class discussion
		10.2.3.8 Demonstrate the effects of friction on the motion of a body.	<ul style="list-style-type: none"> • Effects of friction e.g. heat, wear and tear 		
		10.2.3.9 Describe the motion in a circular path due to a perpendicular	<ul style="list-style-type: none"> • Centripetal force: ($F = m(v^2/r)$) and centrifugal force 		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		force.			
	10.2.4 Moment of forces.	<p>10.2.4.1 Perform calculations based on the principle of moments.</p> <p>10.2.4.2 Investigate the everyday application of moments.</p>	<ul style="list-style-type: none"> • Mass, weight and distance of a uniform object e.g. metre rule, metal bar, plank etc based on the principle • Application of moments e.g. opening a door or window, opening a bottle with an opener, a see-saw, turning a tap on, tightening a nut with a spanner etc 	<ul style="list-style-type: none"> • Experimenting the principle of moments • Calculating mass, weight and perpendicular distances 	<ul style="list-style-type: none"> • Participating in a group actively • Justifying why handles of certain objects are long. e.g. a spanner, wheelbarrow etc
	10.2.5 Work, Energy and Power.	10.2.5.1 Explain the meaning of the terms work, energy and power.	<ul style="list-style-type: none"> • The definition of Work, Energy and Power: Work (force x distance in direction of force) Energy(ability to do work) Power(rate of doing work) • The units of work, energy and power : Work(joule), 	<ul style="list-style-type: none"> • Communicating work, energy and power • Communicating the SI units for work, energy and power 	<ul style="list-style-type: none"> • Justifying importance of conserving sources of energy • Cooperating in group activities

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>10.2.5.2 Identify the units of measurement for work, energy and power</p> <p>10.2.5.3 Calculate work using the appropriate formula</p> <p>10.2.5.4 Identify the different forms of energy</p> <p>10.2.5.5 Explain qualitatively and quantitatively the terms gravitational potential and kinetic energy.</p> <p>10.2.5.6 Describe sources of</p>	<p>Energy(joule) and Power (watt)</p> <ul style="list-style-type: none"> • The formulae of work: Work = (Force) x (distance moved in the line of action of the force) • Different Forms of energy: e.g. mechanical (Kinetic and gravitational potential energy), Chemical, electrical energy etc • Potential and Kinetic Energy: Gravitational potential energy(energy due to position), Kinetic energy(energy due to motion) NB: Gravitational potential energy ($E_p = mgh$) and kinetic energy ($E_k = \frac{1}{2}mv^2$) • Renewable and non-renewable energy: Renewable sources of energy: (solar, wind, hydroelectric, geothermal, bio-gas) Non-renewable energy(chemical/fuel, nuclear energy) • Effects of use of energy sources on the environment: e.g. air pollution, water pollution, deforestation, land degradation etc • Transformation of energy: e.g. chemical energy(Battery) to electric energy (wire)to light energy(bulb) • Principle of conservation of energy 	<ul style="list-style-type: none"> • Calculating work, energy and power using appropriate formulae • Analysing different forms of energy and there sources • Comparing different forms of energy • Communicating renewable and non-renewable resources • Observing the effects of energy sources on the environment • Demonstrating energy transformations • Describing the law of conservation of energy • Calculating numerical energy 	<ul style="list-style-type: none"> • Appreciating the use of clean energy (pollution free energy) • Cooperating in group activities • Being aware that some energy sources are non renewable • Participating actively in groups • Asking questions for more understanding • Applying the law of conservation of energy • Appreciating Albert Einstein

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>renewable and non renewable energy.</p> <p>10.2.5.7 Explain the effects of the use of energy sources on the environment.</p> <p>10.2.5.8 Demonstrate energy transformation from one form to another</p> <p>10.2.5.9 Describe the conservation of energy</p> <p>10.2.5.10 Calculate energy using mass and velocity</p> <p>10.2.5.11 Demonstrate the calculation of efficiency of energy conversion using the appropriate</p>	<ul style="list-style-type: none"> • Calculation of energy: Using the formula ($E = mc^2$) using the formula to solve numerical problems of energy. • Calculation of efficiency of energy: Using the formula (Efficiency = energy output/ energy input x 100%) • Calculation of power: Using the formula (Power = work done/ time) 	<p>problems involving Einstein formula</p> <ul style="list-style-type: none"> • Calculating efficiency • Calculating power from the formula 	<p>formula</p> <ul style="list-style-type: none"> • Applying the formula in determining energy.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		formula 10.2.5.12 Demonstrate calculation of power using the appropriate formula			

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	10.2.6 Simple machines	<p>10.2.6.1 Describe what a simple machine is</p> <p>10.2.6.2 Identify the different types of simple machines.</p> <p>10.2.6.3 Describe the distances moved by the effort and the load in a simple machine</p> <p>10.2.6.4 Explain the terms of Mechanical advantage (MA), Velocity Ratio (VR) and Efficiency.</p> <p>10.2.6.5 Perform calculations involving simple machines</p>	<ul style="list-style-type: none"> • The definition of a simple machine: Enables a large load to be overcome by a small effort • Types of simple machines: e.g. Levers, pulleys, gears, inclined planes, wheel and axle • The relationship between the distance and effort & load in a simple machine: Distance moved by effort and distance moved by the load in the same time • The definition of Mechanical advantage (MA), Velocity Ratio (VR) and Efficiency: Mechanical advantage (MA = Load/Effort) Velocity Ratio (VR = distance moved by effort / distance moved by load) Efficiency (; Efficiency = (MA/VR) x 100%) • Calculation of MA,VR and efficiency of simple machines 	<ul style="list-style-type: none"> • Communicating types of simple machines • Relating the distance moved by the effort to the distance moved by the load at the same time for a particular type of a simple machine • Calculating MA, VR and efficiency of a simple machine 	<ul style="list-style-type: none"> • Cooperating in group activities • Listening to other learners with respect • Appreciating the use of simple machines in doing work e.g. bottle opener • Applying the use the formula to compare MA of different simple machines

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	10.2.7 Pressure	<p>10.2.7.1 Explain what pressure is.</p> <p>10.2.7.2 Describe how pressure relate to force and area using appropriate examples and formula</p> <p>10.2.7.3 Identify factors affecting pressure in liquids.</p> <p>10.2.7.4 Describe the transmission of pressure in hydraulic systems.</p> <p>10.2.7.5 Calculate pressure in liquids.</p> <p>10.2.7.6 Explain the mechanism of a mercury barometer.</p> <p>10.2.7.7 Explain the mechanism of a manometer</p> <p>10.2.7.8 Explain principles</p>	<ul style="list-style-type: none"> • The definition of pressure: Pressure(force/area) Units(pascals, N/m^2, millibars) • The relationship between force and area in pressure and its formulae: Relating force and area as on when force increases pressure increase and when area increase pressure reduce (calculations using the formula $P = F/A$) • Factors affecting pressure in liquids: Depth/height and density of the liquid • Applications of pressure (Pascal’s Law): e.g. hydraulic brakes, hydraulic press and jack • Calculation of pressure in liquids: Using appropriate formula; “$p = \rho gh$” to calculate pressure in liquids • The mechanism of a mercury barometer: Use in determining atmospheric pressure • The mechanism of a manometer: Use in determining gas pressure • Principals of upthrust and floatation in fluids (Archimedes principle) • Relationship of upthrust and floatation 	<ul style="list-style-type: none"> • Measuring pressure using barometer , and manometers • Calculating pressure in fluids • Communicating factors affecting pressure in liquids • Describing the transmission of pressure • Calculating pressure using the formula $p = \rho gh$ • Communicating the principle of Archimedes principle 	<ul style="list-style-type: none"> • Cooperating in group activities • Applying the idea of pressure in our daily life • Appreciating the use of simple machines in doing work e.g. bottle opener • Appreciating the use the formula to calculate pressure • Appreciating the use of a barometer and manometer • Cooperating in group activities • Participating actively in

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		of upthrust and floatation. 10. 2.7.9 Describe how upthrust relate to floatation in fluids.			groups

Grade 11

<p>General Outcomes:</p> <ul style="list-style-type: none"> • Demonstrate an understanding of thermal physics • Develop investigative skills • Demonstrate an understanding of wave motion • Demonstrate an understanding of sound • Demonstrate an understanding of Light • Demonstrate an understanding of magnetism 	<p>Key competences</p> <ul style="list-style-type: none"> • Demonstrate ability to show how pressure varies with volume and temperature • Show skills and knowledge on the construction of thermometers • Demonstrate ability to show heat transfer in solids ,liquids ,and gases • Demonstrate ability to show that sound requires a medium for transmission
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TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.3 Thermal physics	11.3.1 Simple kinetic theory of Matter.	<p>11.3.1.1 Explain What the kinetic theory is</p> <p>11.3.1.2 Describe qualitatively the molecular model of matter.</p> <p>11.3.1.3. Explain changes of state in terms of the kinetic theory of matter.</p> <p>11.3.1.4 Apply kinetic theory to explain rates of diffusion, Brownian motion, evaporation and cooling effect of evaporation.</p> <p>11.3.1.5 Apply the kinetic</p>	<ul style="list-style-type: none"> • The definition of kinetic theory: Matter is made up of discrete individual particles that are continuous in random motion • Structure of matter (solid, liquid, gases) and intermolecular forces: e.g. cohesive and adhesive • Change of state of matter in relation to kinetic theory • Use of kinetic theory as in Rate of diffusion, Brownian motion, evaporation and cooling effect of evaporation in terms of kinetic theory • Kinetic theory in gas 	<ul style="list-style-type: none"> • Predicting the cause of continuous random motion of the discrete individual particles • Interpreting the intermolecular forces i.e. cohesive and adhesive in a much simpler way • Experimenting on the Brownian motion, diffusion, evaporation and cooling. • Collecting the data as experiment • Formulating conclusion of experiment 	<ul style="list-style-type: none"> • Cooperating in group activities • Being aware of the cohesive and adhesive forces in matter • Asking questions for more understanding • Asking more questions for more understanding

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		theory to explain gas pressure.	pressure(compressing a gas in a cylinder)		
	11.3.2 Measurement of temperature	<p>11.3.2.1 Explain what temperature is</p> <p>11.3.2.2 Describe physical properties of substances which change with temperature.</p> <p>11.3.2.3 Measure the temperature with thermometers</p> <p>11.3.2.4 Describe suitability of alcohol and mercury for use in liquid-in-glass thermometers.</p> <p>11.3.2.5 Describe the relationship between</p>	<ul style="list-style-type: none"> • The definition of Temperature: as average kinetic energy of the particles of a substance • Physical properties of substances: such as density, electrical resistance etc of substances • Measurement of temperature and Calibration of thermometers • Suitability in terms of colour, expansion, conductivity. • Relation of Celsius and Kelvin scale 	<ul style="list-style-type: none"> • Communicating information on temperature • Experimenting the thermal expansion of matter(liquid, solid, gases) • Measuring the temperature • Comparing Celsius and Kelvin scale 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in groups activities • Appreciating the use of thermometers in determining temperature • Appreciating the use of thermocouples

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>the Celsius and Kelvin scales.</p> <p>11.3.2.6 Describe the structure and use of a thermocouple thermometer.</p> <p>11.3.2.7 Demonstrate the measurement of temperature using an appropriate thermometer.</p>	<p>($K = t + 273$)</p> <ul style="list-style-type: none"> • Structure of thermal couple: consisting different metals, two junctions, sensitive galvanometer • Appropriate use of thermometers: Liquid in glass thermometers and thermocouple 		
	11.3.3Expansion of solids, liquids and gases.	<p>11.3.3.1Describe qualitatively the thermal expansion of solids, liquids and gases.</p> <p>11.3.3.2 Explain the effects of expansion of water on aquatic life.</p> <p>11.3.3.3Demonstrate that solids, liquids and gases expand at different rates.</p> <p>11.3.3.4Demonstrate how to determine the boiling and melting point of different substances.</p> <p>11.3.3.5Explain effects of pressure on the melting and boiling points.</p>	<ul style="list-style-type: none"> • The thermal expansion of matters: in terms of linear, area and volume expansion • Effects of Anomalous expansion of water • Different rates of expansions of matter • Boiling and melting point of substances: Graphical representation and interpretation • Effects of pressure on melting and boiling point of substances: such as 	<ul style="list-style-type: none"> • Experimenting the thermal expansion of solids, liquids and gases • Communicating the effects of expansion on of water on aquatic life during extreme cold seasons. • Experimenting the boiling and melting points of matters • Collecting the data on temperature and time • Organising the data in graphs. 	<ul style="list-style-type: none"> • Appreciating the knowledge about expansion of solids, liquids and gases. • Cooperating in group activities • Asking questions for more understanding • Being aware of the effects of pressure on boiling and

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>11.3.5.6 Investigate effects of impurities on the melting and boiling points of substances.</p> <p>11.3.3.7 Demonstrate the effect of varying pressure on volume of a gas</p> <p>11.3.3.8 Describe the relationship between temperature and volume of a gas</p> <p>11.3.3.9 Explain the Kelvin scale from the relationship between temperature and volume.</p> <p>11.3.3.10 Demonstrate the use of the ideal gas equation to solve simple numerical problems.</p>	<p>increase in pressure lowers the melting point) Boiling point(increased pressure increases the boiling point)</p> <ul style="list-style-type: none"> • Effects of impurities on the melting and boiling points of substances: such as Impurities lower the melting point while increase the boiling point of a substance • Boils law: use of equation $PV = a \text{ constant at constant pressure}$ • Charles law: as temperature against volume of a gas $V_1/T_1 = V_2/T_2$ • Kelvin Scale; volume-temperature change (constant pressure) Graphical extrapolation • The ideal gas equation ($P_1V_1/T_1 = P_2V_2/T_2$) and numerical problems. 	<ul style="list-style-type: none"> • Analysing the data on graph • Inferring the boiling and melting point of matter • Communicating effects of pressure on melting and boiling points • Investigating the effect of impurities on melting and boiling points • Organising data in the tables to verify the gas laws 	<p>melting points</p> <ul style="list-style-type: none"> • Participating in groups discussion • Asking more questions for more understanding • Applying the use of graphs to relate variables

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	11.3.4 The Engine	<p>11.3.4.1 Explain what an internal combustion engine is.</p> <p>11.3.4.2 Identify the different parts of an internal combustion engine.</p> <p>11.3.4.3 Describe the operation of the spark plug.</p> <p>11.3.4.4 Describe the different strokes in a four stroke internal combustion engine</p> <p>11.3.4.5 Describe efficiency of a diesel and petrol engine</p>	<ul style="list-style-type: none"> • The internal Combustion Engine; The ignition of the mixture of liquid fuel and air, inside the cylinder (Petrol and diesel engine) • Parts of internal combustion engine: such as valves, piston, spark plug, cylinder • The operation of Spark plug (produces a spark). • The strokes in a four stroke internal combustion engine: Intake, compression, power and exhaust. • Efficiency of Diesel engines and petrol engines 	<ul style="list-style-type: none"> • Communicating the operation of an internal combustion engine. • Communicating different parts and different strokes of an internal combustion Engine. • Comparing the most efficient and yet economical engine to use 	<ul style="list-style-type: none"> • Appreciating the use of machines • Asking questions for more understanding • Participating actively in group activities
	11.3.5 Heat transfer by conduction, convection and radiation.	<p>11.3.5.1 Explain methods of heat transfer.</p> <p>11.3.5.2 Use kinetic theory to explain heat transfer.</p> <p>11.3.5.3 Demonstrate heat conduction in different substances.</p> <p>11.3.5.4 Demonstrate the uses</p>	<ul style="list-style-type: none"> • Heat transfer methods :Conduction, convection and radiation • Relationship between kinetic theory and heat transfer • Heat conduction in different substances • Uses of conductors 	<ul style="list-style-type: none"> • Verifying the methods of heat transfer by experimentation • Identifying the relationship between kinetic theory to heat transfer • Communicating 	<ul style="list-style-type: none"> • Participating in group activities during experiments. • Being aware of the fact that heat transfer can be explained in terms of kinetic theory.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>of bad and good conductors of heat.</p> <p>11.3.5.5 Demonstrate convection in liquids and gases.</p> <p>11.3.5.6 Demonstrate the differences between bad and good absorbers of radiant energy</p> <p>11.3.5.7 Demonstrate the differences between good and bad heat emitters.</p> <p>11.3.5.8 Explain everyday's applications of knowledge on conduction, convection and radiation.</p>	<p>Good conductors; pans, kettle, pots etc;</p> <p>Bad conductors; plastic handles, wooden handles etc</p> <ul style="list-style-type: none"> • Heat transfer in fluids through Convection current • Differences between good and bad absorbers of heat: e.g. shiny(white or silver) and dull(black) surfaces • Differences between good and bad emitters of heat such as shining (white or silver) and dull (black surfaces) • Application of knowledge on the processes of heat transfer: e.g. thermos flask, electric kettle ,land and sea breeze, green house effect 	<p>uses of bad and good conductors in everyday life</p> <ul style="list-style-type: none"> • Experimenting good and bad absorbers of radiant heat • Observing heat transfer in fluids • Inferring good and bad emitters of heat. • Investigating the daily applications of the methods of heat transfer 	<ul style="list-style-type: none"> • Cooperating in group activities • Listening to others with respect • Appreciating the knowledge about heat transfer and its application
	11.3.6 Measurements of heat.	11.3.6.1 Demonstrate the difference between temperature and heat energy.	<ul style="list-style-type: none"> • Difference between temperature(level of hotness) and Heat energy(energy transferred) 	<ul style="list-style-type: none"> • Comparing between temperature and heat transfer • Communicating 	<ul style="list-style-type: none"> • Participating in group activities

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>11.3.6.2 Describe the terms of heat capacity and specific heat capacity.</p> <p>11.3.6.3 Identify the SI units of specific heat capacity.</p> <p>11.3.6.4 Demonstrate how to measure specific heat capacity of solids and liquids.</p>	<ul style="list-style-type: none"> • Terms of heat capacity and specific heat capacity: such as Heat capacity (heat to raise temperature by 1K) Specific heat capacity (quantity of heat which raises the temperature of unit mass by 1K.) • SI Units of specific heat capacity: Joules per kilogram Kelvin(J/kg K) • Measurement of Specific heat capacity of solids and liquids through Electrical method and methods of mixture 	<p>heat capacity and specific heat capacity</p> <ul style="list-style-type: none"> • Communicating the SI units for specific heat capacity • Measuring specific heat capacity of solids and liquids 	<ul style="list-style-type: none"> • Being aware of the difference between heat capacity and specific heat capacity • Cooperating in group activities • Appreciating the knowledge about heat capacity
		<p>11.3.6.5 Describe the terms latent heat, specific latent heat of fusion and of vaporisation.</p> <p>11.3.6.6 Demonstrate the solving of numerical problems on heat measurements</p>	<ul style="list-style-type: none"> • Scientific Terms: Latent heat; specific latent heat of fusion (melting) and specific latent heat of vaporization • Numerical problem on latent heat 	<ul style="list-style-type: none"> • Communicating specific latent heat • Calculating numerical problems on heat measurement 	<ul style="list-style-type: none"> • Being aware of latent heat • Appreciating the formula used to calculate latent heat

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.4 Wave motion	11.4.1 Simple ideas of the wave motion theory.	<p>11.4.1.1 Demonstrate wave motion.</p> <p>11.4.1.2 Distinguish between longitudinal and transverse waves.</p> <p>11.4.1.3 Describe the terms associated with waves</p> <p>11.4.1.4 Apply the wave equation in solving wave motion problems</p>	<ul style="list-style-type: none"> • Wave motion: e.g. vibrations in ropes, Springs • Different types of wave: Transverse (water and light waves) and Longitudinal (sound waves) in terms of direction of oscillation • Scientific terms: Amplitude (A), period(T), frequency (f), wavelength (λ) and wave front • The wave equation: Displacement-time and displacement – distance graphs of a wave. (Use the equation $v = f\lambda$.) • Use of waves in our life: 	<ul style="list-style-type: none"> • Designing experiments to demonstrate wave motion by using ropes, strings • Communicating terms associated with waves • Calculating numerical problems using the using the formula: “$v = f\lambda$” • Communicating knowledge on the daily application of waves 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Being aware of the terms associated with wave motion • Appreciating the use of the formula to calculate speed the of a wave

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.4.1.5 Explain the use of waves in everyday life.	radio, television, ultrasonic etc.		• Participating in group activities
	11.4.2 Propagation of waves	11.4.2.1 Explain what propagation, reflection, refraction and diffraction of waves are 11.4.2.2 Demonstrate constructive and destructive interference of waves	<ul style="list-style-type: none"> • Scientific terms: Propagation-transmission, reflection- and refraction of waves. Diffraction of waves using wide, narrow gaps, sharp edges. • Two types of Interference of waves: such as Constructive and destructive 	<ul style="list-style-type: none"> • Experimenting the reflection, refraction and propagation of waves using appropriate apparatus. • Analysing the wave patterns produced by using barriers having different slit sizes 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in class discussion actively
	11.4.3 Electromagnetic spectrum	11.4.3.1 Describe main components of electromagnetic spectrum. 11.4.3.2 Describe the properties of electromagnetic waves	<ul style="list-style-type: none"> • Main components of electromagnetic spectrum: such as Gamma, X-rays, ultra violet, visible light, infrared, microwaves and radio waves • Properties of electromagnetic waves: e.g. transverse in nature, same speed in vacuum (approximately, $c = 3.0 \times 10^8$ m/s) etc • Sources of rays in electromagnetic spectrum: e.g. sun radioactive 	<ul style="list-style-type: none"> • Communicating all components of electromagnetic spectrum • Communicating properties of electromagnetic spectrum • Analysing the sources of each of the electromagnetic rays • Communicating knowledge on how to detect the rays and their 	<ul style="list-style-type: none"> • Being aware of the components of electromagnetic waves and their properties. • Appreciating the knowledge about the existence of electromagnetic radiation. • Cooperating in group activities

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>11.4.3.3 Identify the sources of each of the rays in the electromagnetic spectrum.</p> <p>11.4.3.4 Describe the method of detection each of the main component of the electromagnetic spectrum.</p> <p>11.4.3.5 Explain the use of each of the waves in the electromagnetic radiation spectrum.</p> <p>11.4.3.6 Explain the harmful effects of ultra violet radiation, gamma rays and x-rays to life.</p>	<p>materials, oscillating electrical circuit etc</p> <ul style="list-style-type: none"> • The method for detecting electromagnetic radiation • Uses of electromagnetic waves • Harmful effects of electromagnetic waves e.g. skin cancer etc 	<p>uses</p> <ul style="list-style-type: none"> • Communicating the uses of electromagnetic waves • Investigating the harmful effects radiation 	<ul style="list-style-type: none"> • Participating in groups actively

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.5 Sound	11.5.1 Properties of sound	<p>11.5.1.1 Explain how sound is produced.</p> <p>11.5.1.2 Describe what rarefactions and compressions are.</p> <p>11.5.1.3 Describe the approximate range of audible frequencies.</p> <p>11.5.1.4 Investigate that sounds requires a medium for transmission.</p> <p>11.5.1.5 Determine the speed of sound in air.</p> <p>11.5.1.6 Describe the relative speed of sound in solid, liquid and gas.</p> <p>11.5.1.7 Demonstrate the characteristics of sound waves.</p>	<ul style="list-style-type: none"> • Production of sound using vibrating objects • Sound wave essentials: rarefactions (stretches) and compressions (“Squashes”) • Range of audible sound frequencies (20Hz to 20000Hz) • Effects of sound waves traveling through air and a vacuum • Speed of sound in air (approximately 330m/s) • Respective speeds of sound in solids, liquids and gases • The characteristics of sound waves: Loudness of sound and its amplitude Pitch of sound and its frequency • Factors which influence the quality of sound: 	<ul style="list-style-type: none"> • Experimenting on sound production • Communicating knowledge about wave motion • Designing experiment that sound requires a medium for its propagation through experimentation • Communicating knowledge about the speeds of sound in different medium. • Identifying factors that influence the quality of sound 	<ul style="list-style-type: none"> • Cooperating in group activities • Participating in groups actively • Asking questions for more understanding • Being aware of the fact that sound travels at different speeds in different media • Giving presentation • Listening to others with respect • Appreciating uses of ultrasonic

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>11.5.1.8 Describe the factors which influence the quality of sound.</p> <p>11.5.1.9 Describe what ultrasonic is</p> <p>11.5.1.10 Describe the uses of ultrasonic.</p> <p>11.5.1.11 State how to minimise sound pollution</p>	<p>such as overtones or wave form of the note</p> <ul style="list-style-type: none"> • Ultrasonic: as fundamental frequency of Sounds above human hearing range • Uses of ultrasonic: cleaning, quality control, pre-natal scanning etc. • Measures to minimize sound pollution: such as sound proof structures 	<ul style="list-style-type: none"> • Communicating the uses of ultrasonic • Investigating measures to minimize sound pollution 	

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.6Light	11.6.1 Rectilinear propagation of light	<p>11.6.1.1 Describe the rectilinear propagation of light.</p> <p>11.6.1.2 Investigate the formation of shadows and eclipse.</p> <p>11.6.1.3 Describe reflection of light.</p> <p>11.6.1.4 Investigate the laws of reflection of light</p> <p>11.6.1.5 Demonstrate the formation of images by plane mirrors.</p> <p>11.6.1.6 Identify the position of an image using plane mirrors.</p>	<ul style="list-style-type: none"> • The nature of light: Straight line propagation of light • Formation of shadows(umbra, penumbra) and eclipses(earth in umbra and penumbra) • Reflection of light on smooth and rough surfaces: as being regular and diffuse • Laws of reflection: as angle of incidence = angle of reflection and incident ray, reflected ray and the normal all lie in the same plane. • Image in a plane mirror (virtual, laterally inverted ,position, position and size) • The position of an image: Construction of ray diagrams 	<ul style="list-style-type: none"> • Experimenting the nature of light (light travels in a straight line) • Predicting the formation of shadows and eclipse • Experimenting the laws of reflection • Investigating the characteristics of an image formed by plane mirrors using ray diagrams 	<ul style="list-style-type: none"> • Appreciating the existence of light • Cooperating in group activities • Asking questions for more understanding • Giving presentation • Listening to others with respect • Appreciating image formed by plane image

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	11.6.2 Refraction of light	<p>11.6.2.1 Describe what refraction of light is</p> <p>11.6.2.2 Explain the terms of refraction of light</p> <p>11.6.2.3 Verify the laws of refraction of light.</p> <p>11.6.2.4 Describe what refractive index is.</p> <p>11.6.2.5 Investigate the refractive index of a glass block.</p> <p>11.6.2.6 Calculate refractive index of a substance (n) using real and apparent depth.</p> <p>11.6.2.7 Explain the term ‘critical angle’.</p> <p>11.6.2.8 Describe the relationship between critical angle and refractive index.</p>	<ul style="list-style-type: none"> • Refraction of light: as Bending of light rays after passing through different media. • Incident ray, refracted ray ,normal ray and emergent ray) • Laws of refraction: as The ratio $\sin i/\sin r$ is a constant value(snells law) The incident ray ,the normal, and the refracted ray all lie in the same plane • Refractive index: as Measure of bending of light • Refractive index of glass • Using of formula, refractive index of “substance = real depth/apparent depth” • Critical angle: as angle of incidence at which the angle of refraction is 90° • the relationship between critical angle and refractive index: $n = \sin 90^\circ / \sin c$, Angle of incidence greater than critical angle 	<ul style="list-style-type: none"> • Experimenting the refraction of light • Collecting data on the laws of refraction • Calculating the refractive index • Comparing the refractive index to critical angle • Communicating the total internal reflection 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Applying the knowledge of refraction in daily life • Appreciating the knowledge on total internal reflection and its use.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>11.6.2.9 Explain how total internal reflection occurs.</p> <p>11.6.2.10 Explain how total internal reflection is used.</p>	<ul style="list-style-type: none"> • Internal reflection: all the light reflected inside the more denser medium • Use of internal reflection: optic fibre for communication 		
	11.6. 3 Lenses.	<p>11.6.3.1 Describe different types of lenses.</p> <p>11.6.3.2 Explain the action of lenses on beams of light.</p> <p>11.6.3.3 Demonstrate how to determine the focal length,</p> <p>11.6.3.4 Calculate the power of the converging lens</p> <p>11.6.3.5 Demonstrate how to obtain images formed by converging lenses</p> <p>11.6.3.6 Describe the uses of lenses in everyday life.</p>	<ul style="list-style-type: none"> • Types of lenses; Convex (thin converging) and concave (diverging) • Types of rays: Converge and diverge rays of light • Focal length: NB: use of formula: “$1/f = 1/u + 1/v$, magnification=v/u” • Power of the lens: ($P=1/f$) • Characteristics of image: in terms of the position, size and nature of images formed by converging lenses. • Use of lens: in correcting defects in vision: short sight-concave lens, long sight-convex lens, LCD, Camera etc. 	<ul style="list-style-type: none"> • Communicating different types of lenses • Experimenting to find out what happens to light when passed through lenses. • Inferring the focal length • Predicting the images formed by converging lenses • Investigating the uses of lenses 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Giving presentation of group activity • Listening to others with respect • Accepting responsibility of group work • Appreciating use of lenses

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.7 Magnetism	11.7.1 Simple phenomenon of magnetism.	11.7.1.1 Describe properties of magnets 11.7.1.2 Explain the domain theory of magnetism	<ul style="list-style-type: none"> • Fundamental properties of magnet: such as repulsion, attraction direction N-S ,pole, etc • Domain theory of magnetism 	<ul style="list-style-type: none"> • Communicating knowledge on magnetism theory • Investigating induced magnetism 	<ul style="list-style-type: none"> • Cooperating in group activities • Asking questions for more understanding

		<p>11.7.1.3 Demonstrate induced magnetism.</p> <p>11.7.1.4 Demonstrate the making of a magnet</p> <p>11.7.1.5 Demonstrate the way to destroy a magnet</p> <p>11.7.1.6 Demonstrate the plotting of magnetic field lines.</p> <p>11.7.1.7 Distinguish the magnetic properties of iron and steel.</p> <p>11.7.1.8 Explain the use of magnetic screening and magnetic keepers.</p> <p>11.7.1.9 Describe the uses of magnets.</p>	<ul style="list-style-type: none"> • Induced magnetism: Transfer of magnetic properties without contact • Magnetisation: using stroking and electrical method • Demagnetisation: using methods such as Electrical method, hammering, heating etc • Magnetic field lines: Use of Magnetic compass to plot field lines. • Magnetic properties of Iron (susceptible) and steel (retentive). • The use of magnetic screening and magnetic keepers : Magnetic screening (shielding equipment) and magnetic keepers.(prevent loss of magnetic strength) • Use of magnets in our life: circuit breakers, speakers ,electromagnets 	<ul style="list-style-type: none"> • Experimenting on magnetization and demagnetization • Observing magnetic field lines using a compass and/ or iron filings • Formulating the pattern of magnetic field lines • Communicating information on the uses of magnets 	<ul style="list-style-type: none"> • Participating in group activities actively • Applying the use of magnets in everyday life • Appreciating the uses of magnets
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Grade 12

<p>General Outcomes:</p> <ul style="list-style-type: none"> • Demonstrate an understanding about Static electricity • Develop investigative skills • Demonstrate an understanding of Current Electricity • Demonstrate an understanding about electromagnetic induction • Demonstrate an understanding of basic electronics • Demonstrate an understanding about atomic physics 	<p>Key competences</p> <ul style="list-style-type: none"> • Demonstrate ability to measure current and voltage • Show skills and knowledge to dispose cells and battery • Demonstrate ability to save electricity • Demonstrate ability to cost use of electricity
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TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES

12.8 Static electricity	12.8.1 Static Electricity.	<p>12.8.1.1 Demonstrate the existence of static charges</p> <p>12.8.1.2 Explain how to detect electric charges.</p> <p>12.8.1.3 Describe the properties and uses of static charges</p> <p>12.8.1.4 Describe the electric charging and discharging of objects.</p> <p>12.8.1.5 Explain the relationship between current and static electricity.</p> <p>12.8.1.6 Investigate effects of static charges on the environment.</p>	<ul style="list-style-type: none"> • Existence of static charge: Positive and negative charges (Law of electrostatics) • Detection of charge: charging by contact, testing the sign of charge using gold - leaf electroscope etc • Properties and uses of static charges: -Properties; like charges repel, unlike charges attract -Uses: dust precipitators, ink jet printers, photocopiers. • Electric charging and discharging of objects. • Relationship between current and static electricity in terms of effects as static electricity produces same effect as current electricity. • Effects of static charges on an environment: e.g. lightning etc 	<ul style="list-style-type: none"> • Experimenting the existence of charges by rubbing some materials • Detecting charge using an electroscope • Communicating properties and uses of static charge • Experimenting charging and discharging of objects • Communicating knowledge on the relationship between current and static electricity • Investigating the effects of static charges on the environment e.g. lightning 	<ul style="list-style-type: none"> • Cooperating in group activities • Asking questions for more understanding • Participating in groups actively • Knowing the safe rules of experiment • Being aware of the effects of charges
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TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT
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			KNOWLEDGE	SKILLS	VALUES
12.9 Current electricity	12.9.1 Electric charge, current, and potential difference.	<p>12.9.1.1 Describe the terms associated with electricity</p> <p>12.9.1.2 Identify the units of electric charge and current.</p> <p>12.9.1.3 Demonstrate how to measure an electric current.</p> <p>12.9.1.4 Describe what potential difference is.</p> <p>12.9.1.5 Describe what the volt is.</p> <p>12.9.1.6 Differentiate between potential difference (PD) and electromotive force (EMF).</p> <p>12.9.1.7 Describe the basic concept of EMF.</p> <p>12.9.1.8 Demonstrate the</p>	<ul style="list-style-type: none"> • Scientific Terms: such as Electric charge, potential difference and electric current • Units of electric charge and current: as Coulomb and ampere ($I = Q/t$) • Measure an electric current in the circuit: Ammeter • Potential difference: as energy required to move a unit charge between two points in a circuit • Volt: as joules per coulomb • Difference between PD and EMF in terms of work done per unit of charge in driving charge in a circuit and through a component • The basic concept of EMF • Measurement of PD and EMF: Connecting terminals across source of electric current /conductor 	<ul style="list-style-type: none"> • Measuring an electric current using an ammeter. • Communicating the SI units for voltage • Communicating the concept of the energy dissipated • Measuring potential difference using a voltmeter 	<ul style="list-style-type: none"> • Participating in groups actively • Cooperating in group works • Appreciating the use of electrical appliance • Knowing the safe rules of experiment

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		measuring of potential difference (PD) and electromotive force (EMF).			
	12.9.2 Electric cells.	<p>12.9.2.1 Describe the structure of primary and secondary cells.</p> <p>12.9.2.2 Demonstrate charging and discharging of the accumulator.</p> <p>12.9.2.3 Identify methods of disposal of used cells</p>	<ul style="list-style-type: none"> • Structure of primary and secondary cells: Primary cells(dry cell), Secondary (lead acid accumulator) • How to charge and discharge the accumulator: Charging when current is passed a in opposite direction to current supplies, discharging when in use (acid accumulator) • Appropriate methods of disposing used cells. 	<ul style="list-style-type: none"> • Communicating the structure of cells • Investigating charging and discharging an acid accumulator • Communicating appropriate methods of disposing off used cells 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Applying the knowledge of disposal of cells in dairy life
	12.9.3 Electrical resistance.	<p>12.9.3.1 Explain the meaning of the resistance</p> <p>12.9.3.2 Demonstrate how to determine resistance in a simple circuit.</p>	<ul style="list-style-type: none"> • Resistance: opposition to the flow of charge • Value of resistance in series and parallel (use formula $1/R = 1/R_1 + 1/R_2$) • Relationship between 	<ul style="list-style-type: none"> • Measuring the current and potential difference, using a voltmeter and an ammeter • Collecting data as experiment 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>12.9.3.3 Describe the relationship between current and potential difference in Ohmic and non Ohmic conductors.</p> <p>12.9.3.4 Describe what the internal resistance of a cell is.</p> <p>12.9.3.5 Calculate the resistance in series and parallel circuits with Ohm's law.</p>	<p>current and potential difference: (Graph of p.d. against current for Ohmic and non-Ohmic conductors)</p> <ul style="list-style-type: none"> • Internal resistance of a cell • Ohm's law in series and parallel circuits. ($R = V/I$) 	<ul style="list-style-type: none"> • Organising data in tables and their graphs on ohmic and non ohmic conductor • Formulating the patterns in data 	<p>group activities actively</p> <ul style="list-style-type: none"> • Knowing the safe rules of experiment
	12.9.4 Heating effect of an electric current.	<p>12.9.4.1 Demonstrate energy transformations in an electric circuit.</p> <p>12.9.4.2 Investigate the heating effect of an electric current.</p> <p>12.9.4.3 Demonstrate how to calculate</p>	<ul style="list-style-type: none"> • Conversion of energy from electricity to heat. • Heating effect of an electric current in heating appliances. • Calculations of electrical energy: Use of formula ($E = VIt$, etc.) 	<ul style="list-style-type: none"> • Analysing energy changes from one form to the other • Investigating the heating effect of an electric current • Calculating electrical energy using $E = VIt$ 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>electrical energy.</p> <p>12.9.4.4 Describe the relationship of voltage, current and power.</p> <p>12.9.4.5 Demonstrate how to calculate the cost of using electrical Energy</p> <p>12.9.4.6 Describe the use of switches, fuses, earthing and the three pin-plugs.</p> <p>12.9.4.7 Explain the need for earthing metal cases and for double Insulation.</p> <p>12.9.4.8 Describe the meaning of three wires found in the cable</p> <p>12.9.4.9 Describe the domestic</p>	<ul style="list-style-type: none"> • The relationship of voltage, current and power: Power = voltage x current($P=VI$) • Cost of using electrical energy: use of kWh as a unit of electrical energy • Electrical components: e.g. switches (on /off power), fuses (prevent appliances from damage), and the three pin-plugs (connecting appliance). • Safety precautions (prevent electric shocks, accidents) • Three types of Wires: Live (red or brown), earthing (green and yellow) and neutral (blue) • Household circuits: such as cooker circuit, ring circuit, lighting circuit • Ways of conserving electrical energy: using energy saving bulbs, switch 	<ul style="list-style-type: none"> • Communicating relationship among power, voltage and current • Calculating the cost of using electrical energy • Communicating the use of some named electrical components • Investigating the safety precautions • Communicating the colouring of insulators • Investigating the basic wiring system in a house • Communicating ways of conserving energy 	<ul style="list-style-type: none"> • Appreciating the use of electricity at home • Cooperating in group activities • Applying the safety precautions in the use of electricity • Appreciating the use of energy saving bulbs

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		electrical wiring system 12.9.4.10 Describe ways of conserving electrical energy in homes and industry.	and serve etc.		
	12.9.5 Magnetic effects of electric currents.	12.9.5.1 Explain magnetic field patterns of electric currents. 12.9.5.2 Describe the applications of the magnetic effect of an electric current. 12.9.5.3 Explain the behaviour of an electric current in a magnetic field. 12.9.5.4 Describe the application of a current placed in a magnetic field. 12.9.5.5 Describe the nature of forces	<ul style="list-style-type: none"> • Lines of force (Magnetic flux) : patterns of electric currents • Applications of electromagnets: electric bells, relay switches etc • The behaviour of an electric current in a magnetic field: or electron beam • Applications of current in a magnetic field: e.g. D.C. motors, galvanometers, ammeter etc • Nature of forces: attraction and repulsion of forces between parallel currents. 	<ul style="list-style-type: none"> • Experimenting the magnetic field patterns of electric currents • Communicating use of electromagnets • Investigating the displacement of a current carrying wire in a field • Inferring the attraction and repulsion of forces between parallel currents • Investigating the effects of magnetic fields 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Asking questions for more understanding • Applying the effects of magnetic field

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>between parallel currents.</p> <p>12.9.5.6 Describe the effect of magnetic fields on human health and environment.</p>	<ul style="list-style-type: none"> • Effects of magnetic fields: hearing impairment, radar interference in communication, etc 		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.10 Electromagnetic induction	12.10.1 The phenomenon of electromagnetic induction.	<p>12.10.1.1 Investigate the phenomenon of electro-magnetic induction.</p> <p>12.10.1.2 Describe the factors affecting magnitude and direction of induced EMF.</p> <p>12.10.1.3 State the direction of current produced by an induced EMF.</p>	<ul style="list-style-type: none"> • Electromagnetic induction: (induced EMF / current in a wire moving cutting magnetic flux) Faraday’s law • Factors affecting magnitude and direction of induced EMF: speed of either magnet or coil, strength of magnet, number of turns of a coil • Direction of induced current: Lenz and Fleming right hand law. 	<ul style="list-style-type: none"> • Experimenting the induction of an EMF/current using a magnet, a coil and ammeter • Collecting data • Organising the data in a table • Interpreting the data • Analysing the factors that affect the magnitude of the induced current/EMF • Inferring the direction of induced current with Fleming right hand rule 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Knowing the safe rules of experiment
	12.10.2 The simple A.C. and D.C. generators.	<p>12.10.2.1 Describe simple A.C. and D.C. generators.</p> <p>12.10.2.2 Compare the simple A.A. generator with a simple D.C. generator in terms of structure and its nature.</p> <p>12.10.2.3 Describe the action</p>	<ul style="list-style-type: none"> • Generators: simple A.C. generator (an alternator with slip-rings) and simple D.C. dynamo with a commutator • Structure and its nature of simple A.C and D.C generators • Action of diodes: change A.C. to D.C. by allowing current to flow 	<ul style="list-style-type: none"> • Communicating A.C. and D.C. generators • Comparing the structure and nature of an A.C. and D.C. generators • Communicating rectification of 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>of a diode in rectification.</p> <p>12.10.2.4 Explain conversion of an A.C. generator to a D.C. generator.</p> <p>12.10.2.5 Contrast the current produced by the D.C. generator with that produced from batteries.</p>	<p>one way</p> <ul style="list-style-type: none"> • Conversion of A.C. generator to D.C. generator by use of commutator • The direction of Current from D.C generator(varies) and from batteries(constant) 	<p>alternating current using diodes</p> <ul style="list-style-type: none"> • Comparing the direction of current produced by a D.C. generator to the one produced from batteries 	<ul style="list-style-type: none"> • Appreciating the use of the generators and batteries
	12.10.3 Transformers.	<p>12.10.3.1 Demonstrate the principles of mutual induction.</p> <p>12.10.3.2 Describe the structure and operation of iron core transformers.</p> <p>12.10.3.3 Apply the transformer and power equations to solve numerical problems involving ideal transformers</p> <p>12.10.3.4 Calculate the efficiency of a</p>	<ul style="list-style-type: none"> • Principles of mutual induction: changing current in one coil gives rise to current in the other • The structure and operation of iron core transformers • Equations of transformer and power: using relations $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ and $V_p I_p = V_s I_s$ (ideal transformer) • Calculation of efficiency: [Efficiency = $(V_s I_s) / (V_p I_p) \times 100\%$] 	<ul style="list-style-type: none"> • Designing investigations to verify mutual induction • Communicating step up and step down transformers • Calculating problems relating to the transformers and power using formulae • Calculating the efficiency of a transformer 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Appreciating the use of the formula • Being aware of the environmental and cost implications of

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>transformer given data.</p> <p>12.10.3.5 Explain advantages of high alternating potential difference power transmission.</p> <p>12.10.3.6 Describe the implications of underground power transmission compared to overhead lines.</p> <p>12.10.3.7 Describe the effects of improper management of transformers</p>	<ul style="list-style-type: none"> • Advantage of high alternating potential difference power transmission: as in reducing power losses in cables. • Environmental and cost implications of underground power transmission • Effects of improper management of Transformers such as overheating, low/high voltage 	<ul style="list-style-type: none"> • Communicating knowledge on the environmental and cost implications of underground power transmission 	<p>underground power transmission</p>

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.11 Basic electronics	12.11.1 Thermionic emission and electrons.	12.11.1.1 Describe What thermionic emission is	<ul style="list-style-type: none"> • Thermionic emission: release of electrons from a heated cathode • Properties of cathode rays: e.g. Deflected by electric and magnetic fields travel in straight in lines etc. • Direction of flow of electrons and conventional current • Application of electron beams in CRO ,TV set, X-ray machines etc • Basic structure and action of CRO: electron gun, Control grid, anode Y-plates ,X-plates, fluorescent screen • Uses of CRO: e.g. measuring(peak voltage, time, frequency),TV etc 	<ul style="list-style-type: none"> • Investigating properties of cathode rays by using a CRO • Comparing the direction of flow of electrons to conventional current • Communicating the devices that make of electron beams in their operation • Investigating the basic structure of a CRO. • Measuring quantities using a CRO 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Appreciating the use of the cathode rays in specific devices • Being aware of the structure of a CRO • Appreciating the use of a CRO in measuring some quantities
		12.11.1.2 Investigate properties of cathode rays			
12.11.1.3 Distinguish between direction of flow of electrons and flow of conventional current.					
12.11.1.4 Describe applications of electron beams.					
12.11.1.5 Describe basic structure and action of cathode-ray oscilloscope.					
12.11.1.6 Describe the uses of cathode-ray oscilloscope.					
	12.11.2 Circuit components.	12.11.2.1 Identify symbols of basic circuit component.	<ul style="list-style-type: none"> • Circuit components and its symbols: such as resistors, potentiometers, capacitors, thermistors, light dependent resistors, reed switches and relays switches, light emitting diodes etc • Values of resistors recognised from the colour bands 	<ul style="list-style-type: none"> • Communicating the basic circuit components • Calculating resistance using standard colour codes and values 	<ul style="list-style-type: none"> • Cooperating in group activities • Asking questions for more understanding • Participating in
		12.11.2.2 Determine resistor values			

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>using standard colour codes.</p> <p>12.11.2.3 Describe action of variable potential divider.</p> <p>12.11.2.4 Explain the action and application of thermistor and light dependent resistors.</p> <p>12.11.2.5 Investigate the charging and discharging of capacitors.</p> <p>12.11.2.6 Describe the role of capacitors in electronic equipments.</p> <p>12.11.2.7 Explain how a reed and relay switches work.</p> <p>12.11.2.8 Describe application of reed switch and reed relay.</p>	<ul style="list-style-type: none"> • Action of variable potential divider • Action of thermistor (as semi conductor) and application of thermistor and light dependent resistors (sensitive to temperature changes in light intensity) • Charging and discharging of capacitors: Charging through a resistor when connected to current flow and discharging through a resistor when not connected to current flow. • Role of capacitors in electronic equipments: filter circuits ,delay circuits, smoothening rectified current etc • Works of reed switch and relay switches (by attraction of two iron reeds to switch on / off current and relay switch (as an amplifier) • Application of reed and relay switch: alarm bells, starter motor, telephone 	<ul style="list-style-type: none"> • Investigating the variable potential divider • Communicating the daily applications of thermistor and light dependent resistors • Experimenting the charging and discharging of a capacitor • Communicating the role played by capacitors in electronic equipments • Communicating how reed and relay switches work • Comparing the application of reed and relay switches 	<p>group activities actively</p> <ul style="list-style-type: none"> • Appreciating the use of the thermistors and LDRs in devices

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.11.3 Simple Electronic Systems.	<p>12.11.3.1 Describe the action of a bipolar transistor.</p> <p>12.11.3.2 State the different types of logic gates.</p> <p>12.11.3.3 Demonstrate how to derive the truth tables of logic gates.</p> <p>12.11.3.4 Describe the use of bistable and astable circuits.</p>	<ul style="list-style-type: none"> Action of a bipolar transistor current amplifier: bipolar transistor as used in electronic switches Types of Logic gates: such as NOT ,AND, OR,NAND, NOR How to derive the truth tables of logic gates. The Use of c bistable and astable circuits: ross-coupled logic gates. (Bistable) in computers for data storage. Astable as pulse generator and the used in clocks that controls operations in a computer 	<ul style="list-style-type: none"> Communicating the action of a bipolar transistor Communicating different types of logic gates Investigating truth tables of logic gates using numbers of 0 and 1 in inputs and out puts Communicating the use of cross-coupled logic gates Investigating to show how a bistable and abistable work 	<ul style="list-style-type: none"> Asking questions for more understanding Cooperating in group activities Appreciating the use of the truth tables when dealing with logic gates Participating in group activities actively

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.12. Atomic physics	12.12.1 Nuclear atom	<p>12.12.1.1 Describe the structure of the atom.</p> <p>12.12.1.2 Describe the composition of the nucleus in terms of protons and neutrons.</p> <p>12.12.1.3 Explain mass number and atomic number.</p>	<ul style="list-style-type: none"> • Atomic structure (nucleus and electrons) • Composition of the nucleus (protons and neutrons) • Mass number and Atomic number: mass (Nucleon) number, A, and atomic (proton), number, Z. 	<ul style="list-style-type: none"> • Communicating an atomic structure • Communicating knowledge on the existence of protons and neutrons in the nucleus of an atom 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities
	12.12.2 Radioactivity.	<p>12.12.2.1 Describe the nature of radioactivity.</p> <p>12.12.2.2 Describe the characteristics of the three kinds of radioactive radiations: alpha, beta and gamma.</p> <p>12.12.2.3 Describe methods of detecting radioactive emissions.</p> <p>12.12.2.4 Explain the origin and effects of background radiations</p> <p>12.12.2.5 Describe what radioactive decay is.</p>	<ul style="list-style-type: none"> • Nature of radioactivity (randomness and spontaneity) • Characteristics of three kinds of radioactive radiations: Alpha (α), Beta (β) and Gamma (γ) radiations in terms of penetration, ionization, deflection, charge, relative mass and nature of particles) • Detection of radioactive emissions: by G.M tube, photographic plate, scintillation counter, bubble chamber • Causes of background radiation (cosmic rays, radioactive elements under rocks.) • Radioactive decay as disintegration of nucleus by alpha, beta and gamma emissions. 	<ul style="list-style-type: none"> • Investigating the nature of radioactivity • Investigating radiation using a G.M counter • Understanding the causes and effects of background radiation • Comparing nuclear fission to nuclear fusion • Calculating half life of a radioactive material by using decay curves • Communicating the uses of radioactive substances 	<ul style="list-style-type: none"> • Asking questions for more understanding • Cooperating in group activities • Appreciating the use of a GM counter to detect radiation • Being aware of the existence of background radiation and its effects • Appreciating the use decay curves

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		<p>12.12.2.6 Describe what nuclear fusion and fission is.</p> <p>12.12.2.7 Demonstrate how to determine half life of a radioactive material.</p> <p>12.12.2.8 Explain uses of radioactive substances.</p> <p>12.12.2.9 Describe the safety precautions necessary when handling or storing radioactive substances.</p> <p>12.12.2.10. Explain the effects of radioactive substances on the environment and health.</p> <p>12.12.2.11. Investigate management practices which safeguard the environment from radioactive contamination.</p>	<ul style="list-style-type: none"> • Nuclear fusion and fission: Nuclear fusion as process of joining very light nuclei together and fission as splitting process of nucleus • Half life of a radioactive material: Time taken for activity to reduce by half of the original substance (Decay curves) • Uses of radioactive substances: e.g. medical, industrial, agricultural uses • Use of protective materials: such as gloves, goggles, overalls and lead shields • Effect of radioactive substances: such as radiation pollution and health hazards • Appropriate management safe guard practices 	<ul style="list-style-type: none"> • Communicating knowledge on safety precautions • Investigating management practices which safeguard the environment from radioactive contamination 	<p>to determine half life</p> <ul style="list-style-type: none"> • Participating in group activities actively • Applying safety precautions when dealing with radioactive substances

PRACTICAL PHYSICS

The importance of practical work in Physics cannot be over emphasized. Practical work develops manipulative skills in the learner and gives the learner the opportunity to experiment the scientific method. Needless to mention practical Physics is essential for this syllabus because:

- a) There is need to expose learners to practical applications of Physics.
- b) Learners should understand, interpret and apply scientific methods in a variety of ways including the theoretical and practical approaches.
- c) The study of Physics should be linked with environmental education requirements by quoting local phenomena in relation to Physics studies.

There are scientific processes and skills to which learners must be exposed. Examples of these are observing, experimenting, classifying, measuring, estimating, calculating, predicting and problem solving. Learners should also be exposed to scientific attitude like accuracy, curiosity and creativity.

KEY QUANTITIES, SYMBOLS AND UNITS IN PHYSICS.

The pages 38 – 41 comprise the symbols and units which may from time to time be used during the study of Physics. The candidate is expected to have the knowledge of how to apply the symbols and units in physics.

The list is not exhaustive; therefore the teacher and the learner are expected to discover more as they go through this Course.

LIST OF SUGGESTED APPARATUS AND EQUIPMENT FOR THE SYLLABUS

1.0 Measurements and Mechanics

Venier callipers, micrometer screw gauges, measuring cylinders, metre rules, displacement cans, beakers, conical flasks, different masses such as 50g, 100g, 200g, 1kg, ticker tape timers, pipettes, burettes, spring balances, beam balances, capillary tubes and pulleys.

2.0 Thermal physics

Mercury barometers, clinical and laboratory thermometer, six's maximum and minimum thermometers, manometers, calorimeter, thermos flasks, thermocouple thermometers and hypsometer.

3.0 Light

Plane mirrors, converging and diverging lenses, rectangular and triangular prisms, optical pins, colour discs, colour filters, optical camera, light ray boxes, coloured bulbs, projectors such as slide projectors and film projectors.

4.0 Sound

Sonometers, tuning forks, stop watches, stop clocks, sources of sound such as guitars and drums.

5.0 Magnetism

Bar magnets, horseshoe magnets, iron and steel bars, iron filings and plotting compasses.

6.0 Wave motion

Ripple tanks, springs and spiral springs, ropes and strings.

7.0 Electric current/static electricity

Ammeters, voltmeters, rheostats, capacitors, connecting wires, lead-acid accumulators, dry cells, resistors, tapping keys, switches, fuses, semi-conductors, semi-conductor diodes, electric bells, resistance wires, ebonite and polythene rods, three-pin-plugs, electric bulbs, switch boards and gold leaf electroscopes.

8.0 Basic electronics

Cathode ray tubes, maltese cross tube, resistors, light dependant rays (LDRs), thermistors, diodes, capacitors, transistors, TV sets, radios, electronics teaching kits and computers.

9.0 Nuclear physics

Geiger muller tube, time scales, rate metres, cloud chambers, bubble chamber alpha emitting radioactive sources and extra high tension (EHT) power supply unit.

KEY QUANTITIES, SYMBOLS AND UNITS.

Quantity	Symbols	Unit
Mass	m	kg
Length	l	m
Time	t	s
Electric current	I	A
Thermodynamic temperature	T	K
Amount of substance	n	mol
Distance	d	m
Displacement	s, x	m
Area	An	m ²
Volume	V	m ³
Density	ρ	kgm ⁻³

Speed	u, v	ms^{-1}
Velocity	u, v	ms^{-1}
Acceleration	and	ms^{-2}
Acceleration of free-fall	g	ms^{-2}
Force	F	N
Weight	W	N
Momentum	P	Ns
Work	W	J
Energy	E, U, W	J
potential energy	E_p	J
Kinetic energy	E_k	J
Heat energy	Q	J
Change of internal-energy	ΔU	J
Power	P	W
Pressure	P	Pa
Torque	T	Nm
Gravitational constant	G	$\text{Nkg}^{-2}\text{ms}^2$
Period	T	s
Frequency	f	Hz
Wave length	λ	m
Speed of electromagnetic-waves	c	ms^{-1}
Avogadro constant number	N_A	mol^{-1}
Celsius temperature	θ	$^{\circ}\text{C}$
Half - life	$t_{1/2}$	s
Decay constant	λ	s^{-1}
Specific heat capacity	c	$\text{JK}^{-1}\text{KG}^{-1}$
Electromotive force	E	V
Resistance	R	Ω

Resistivity ρ Ωm

DATA AND FORMULAE

Speed of light in free space $C = 3.00 \times 10^8 \text{ ms}^{-1}$
 Elementary charge $e = 1.60 \times 10^{-19} \text{ coulomb}$
 The Planck constant $h = 6.63 \times 10^{-34} \text{ Js}$
 Molar gas constant $R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1}$
 The Avogadro constant $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
 Gravitational constant $G = 6.67 \times 10^{-11} \text{ Nm}^2\text{kg}^{-2}$
 Acceleration of free fall $g = 9.81 \text{ ms}^{-2}$
 The Boltzmann constant $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$
 Uniformly accelerated motion $s = ut + \frac{1}{2} at^2$
 Or
 $v^2 = u^2 + 2as$
 Work done on/by a gas $W = P\Delta V$
 gravitational potential $E_p = mgh$
 Energy in motion $E = mc^2$
 Refractive index $n = \frac{\sin i}{\sin r}$
 Resistors in series $R = R_1 + R_2 + R_3 + \dots$
 Resistors in parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots +$
 Electric potential $V = Q/4\pi\epsilon_0 r$
 Capacitors in series $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$

$$C = C_1 + C_2 + C_3 + \dots$$

Capacitors in parallel
pressure of an ideal gas

$$C = C_1 + C_2 + C_3 + \dots$$

$$P = \frac{1}{3} \frac{NMC^2}{V}$$

alternating current/voltage
hydrostatic pressure
energy of charged capacitor
radio-active decay
Decay constant

$$X = x_0 \sin \omega t$$

$$P = \rho gh$$

$$w = \frac{1}{2} QV$$

$$x = x_0 \exp(-\lambda t)$$

$$\lambda = \frac{0.693}{t_{1/2}}$$

SCOPE and SEQUENCE

The following table shows the “Scope and Sequence” of Physics syllabus from G10 to G12.

Grade 10		Grade 11		Grade 12	
Unit 1 Measurements	SUBTOPIC	Unit 3 Thermal Physics	SUBTOPIC	Unit 8 Static electricity	SUBTOPIC
	10.1.1 International System of Units (SI).		11.3.1 Simple kinetic theory of Matter.		12.8.1 Static Electricity
	10.1.2 Length and time		11.3.2 Measurement of temperature	Unit 9 Current electricity	12.9.1 Electric charge, current, and potential difference.
	10.1.3 Mass and, weight		11.3.3 Expansion of solids, liquids and gases.		12.9.2 Electric cells.
	10.1.4 Density		11.3.4 Heat transfer by conduction, convection and radiation.		12.9.3 Electrical resistance
Unit 2 Mechanics	10.2.1 Scalars and vectors	Unit 4 Wave motion	11.3.5 Measurements of heat	Unit 10 Electromagnetic induction	12.9.4 Heating effect of an electric current
	10.2.2 Linear motion		11.4.1 Simple ideas of the wave motion theory.		12.9.5 Magnetic effects of electric currents
	10.2.3 Forces		11.4.2 Propagation of waves		12.10.1 The phenomenon of electromagnetic induction
	10.2.4 Moment of forces		11.4.3		12.10.2 The simple A.C. and D.C. generators
	10.2.5 Work,				12.10.3 Transformers

	Energy and Power.		Electromagnetic spectrum	Unit 11 Basic electronics	12.11.1 Thermionic emission and electrons
	10.2.6 Simple machines	Unit 5 Sound	11.5.1 Properties of sound		12.11.2 Circuit components.
		Unit 6 Light	11.6.1 Rectilinear propagation of light.		12.11.3 Simple electronic systems
			11.6.2 Refraction of light		12.11.4 Impact of electronics on society and industry.
	10.2.7 Pressure		11.6.3 Thin converging and diverging lenses.	12.12. Atomic physics	12.12.1 Nuclear atom
		Unit 7 Magnetism	11.7.1 Simple phenomenon of magnetism		12.12.2 Radioactivity