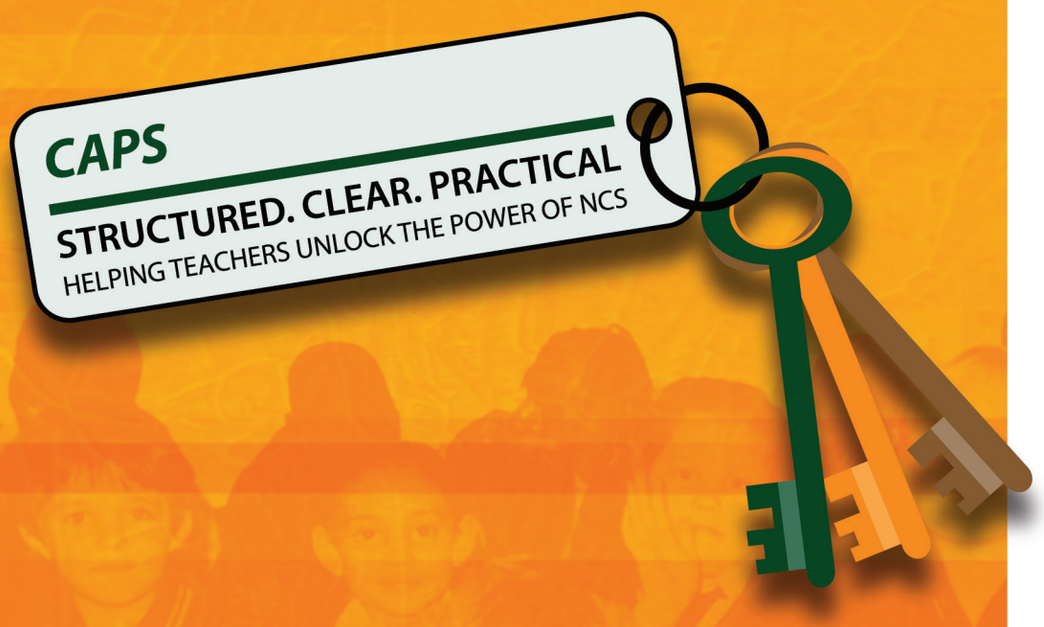
TECHNICAL SCIENCES

National Curriculum Statement (NCS)

Curriculum Assessment Policy Statement



GRADES 10 – 12

basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

CURRICULUM AND ASSESSMENT POLICY STATEMENT (CAPS)

GRADES 10 – 12

TECHNICAL SCIENCES

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FOREWORD BY THE MINISTER

Our national curriculum is the culmination of our efforts over a period of seventeen years to transform the curriculum bequeathed to us by apartheid. From the start of democracy we have built our curriculum on the values that inspired our Constitution (Act 108 of 1996). The Preamble to the Constitution states that the aims of the Constitution are to:

- heal the divisions of the past and establish a society based on democratic values, social justice and fundamental human rights;
- improve the quality of life of all citizens and free the potential of each person;
- lay the foundations for a democratic and open society in which government is based on the will of the people and every citizen is equally protected by law; and
- build a united and democratic South Africa able to take its rightful place as a sovereign state in the family of nations.

Education and the curriculum have an important role to play in realising these aims.

In 1997 we introduced outcomes-based education to overcome the curricular divisions of the past, but the experience of implementation prompted a review in 2000. This led to the first curriculum revision: the *Revised National Curriculum Statement Grades R-9* and the *National Curriculum Statement Grades 10-12* (2002).

Ongoing implementation challenges resulted in another review in 2009 and we revised the *Revised National Curriculum Statement* (2002) to produce this document.

From 2012 the two 2002 curricula, for *Grades R-9* and *Grades 10-12* respectively, are combined in a single document and will simply be known as the *National Curriculum Statement Grades R-12.* The *National Curriculum Statement for Grades R-12* builds on the previous curriculum but also updates it and aims to provide clearer specification of what is to be taught and learnt on a term-by-term basis.

The *National Curriculum Statement Grades R-12* accordingly replaces the Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines with the

(a) Curriculum and Assessment Policy Statements (CAPS) for all approved subjects listed in this document;

(b) *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R – 12*; and

(c) *National Protocol for Assessment Grades R – 12.*

MRS ANGIE MOTSHEKGA, MP

MINISTER OF BASIC EDUCATION

CONTENTS

SECTION 1

INTRODUCTION TO THE CURRICULUM AND ASSESSMENT POLICY STATEMENTS FOR TECHNICAL SCIENCES

GRADES 10 – 12

1.1 Background

The *National Curriculum Statement Grades R – 12 (NCS)* stipulates policy on curriculum and assessment in the schooling sector. To improve implementation, the National Curriculum Statement was amended, with the amendments coming into effect in January 2012. A single comprehensive Curriculum and Assessment Policy document was developed for each subject to replace Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines in Grades R – 12.

1.2 Overview

(a) The *National Curriculum Statement Grades R – 12 (January 2012)* represents a policy statement for learning and teaching in South African schools and comprises the following:

(i) Curriculum and Assessment Policy Statements for each approved school subject;

(ii) The policy document, *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R – 12;* and

(iii) The policy document, *National Protocol for Assessment Grades R – 12 (January 2012).*

(b) The *National Curriculum Statement Grades R – 12 (January 2012)* replaces the two current national curricula statements, namely the

(i) *Revised National Curriculum Statement Grades R – 9, Government Gazette No. 23406 of 31 May 2002,* and

(ii) *National Curriculum Statement Grades 10 – 12 Government Gazettes, No. 25545 of 6 October 2003 and No. 27594 of 17 May 2005.*

(c) The national curriculum statements contemplated in subparagraphs b (i) and (ii) comprise the following policy documents, which will be incrementally repealed by the *National Curriculum Statement Grades R – 12 (January 2012)* during the period 2012 – 2014:

(i) *The Learning Area/Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines for Grades R – 9 and Grades 10 – 12;*

(ii) The policy document, *National Policy on assessment and qualifications for schools in the General Education and Training Band,* promulgated in Government Notice No. 124 in *Government Gazette No. 29626 of 12 February 2007;*

(iii) The policy document, the *National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF),* promulgated in *Government Gazette No.27819 of 20 July 2005;*

(iv) The policy document, *An addendum to the policy document, the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF), regarding learners with special needs***,** published in *Government Gazette, No.29466 of 11 December 2006,* is incorporated in the policy document, *National policy pertaining to the programme and promotion requirements of the National*

Curriculum Statement Grades R – 12; and

(v) The policy document, *An addendum to the policy document, the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF), regarding the National Protocol for Assessment (Grades R – 12),* promulgated in Government Notice No.1267 in *Government Gazette No. 29467 of 11 December 2006.*

(d) The policy document, *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R – 12*, and the sections on the Curriculum and Assessment Policy as contemplated in Chapters 2, 3 and 4 of this document constitute the norms and standards of the *National Curriculum Statement Grades R – 12.* It will therefore, in terms of *section 6A* of the *South African Schools Act,1996 (Act No. 84 of 1996,)* form the basis for the Minister of Basic Education to determine minimum outcomes and standards, as well as the processes and procedures for the assessment of learner achievement to be applicable to public and independent schools.

1.3 General aims of the South African Curriculum

(a) The *National Curriculum Statement Grades R – 12* gives expression to the knowledge, skills and values worth learning in South African schools. This curriculum aims to ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives. In this regard, the curriculum promotes knowledge in local contexts, while being sensitive to global imperatives.

(b) The *National Curriculum Statement Grades R – 12* serves the purposes of:

- equipping learners, irrespective of their socio-economic background, race, gender, physical ability or intellectual ability, with the knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country;
- providing access to higher education;
- facilitating the transition of learners from education institutions to the workplace; and
- providing employers with a sufficient profile of a learner's competences.

(c) The *National Curriculum Statement Grades R – 12* is based on the following principles:

- Social transformation: ensuring that the educational imbalances of the past are redressed, and that equal educational opportunities are provided for all sections of the population;
- Active and critical learning: encouraging an active and critical approach to learning, rather than rote and uncritical learning of given truths;
- High knowledge and high skills: the minimum standards of knowledge and skills to be achieved at each grade are specified and set high, achievable standards in all subjects;

TECHNICAL SCIENCES

- Progression: content and context of each grade shows progression from simple to complex;
- Human rights, inclusivity, environmental and social justice: infusing the principles and practices of social and environmental justice and human rights as defined in the Constitution of the Republic of South Africa. The *National Curriculum Statement Grades R – 12* is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors;
- Valuing indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution; and
- Credibility, quality and efficiency: providing an education that is comparable in quality, breadth and depth to those of other countries.

(d) The *National Curriculum Statement Grades R – 12* aims to produce learners that are able to:

- identify and solve problems and make decisions using critical and creative thinking;
- work effectively as individuals and with others as members of a team;
- organise and manage themselves and their activities responsibly and effectively;
- collect, analyse, organise and critically evaluate information;
- communicate effectively using visual, symbolic and/or language skills in various modes;
- use science and technology effectively and critically, showing responsibility towards the environment and the health of others; and
- demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation.

(e) Inclusivity should become a central part of the organisation, planning and teaching at each school. This can only happen if all teachers have a sound understanding of how to recognise and address barriers to learning, and how to plan for diversity.

The key to managing inclusivity is ensuring that barriers are identified and addressed by all the relevant support structures within the school community, including teachers, District-based Support Teams, Institutional-level, Support Teams, parents and Special Schools as Resource Centres. To address barriers in the classroom, teachers should use various curriculum differentiation strategies such as those included in the Department of Basic Education's *Guidelines for Inclusive Teaching and Learning* (2010).

1.4 Time Allocation

1.4.1 Foundation Phase

(a) The instructional time for **each subject** in the Foundation Phase is indicated in the table below:

Subject	Time allocation per week (hours)
i. Languages (FAL and HL)	10 (11)
ii. Mathematics	7
iii. Life Skills	6 (7)
• Beginning Knowledge	1 (2)
• Creative Arts	2
• Physical Education	2
• Personal and Social Well-being	1

(b) Total instructional time for Grades R, 1 and 2 is 23 hours and for Grade 3 is 25 hours.

(c) To Languages 10 hours are allocated in Grades R – 2 and 11 hours in Grade 3. A maximum of 8 hours and a minimum of 7 hours are allocated to Home Language and a minimum of 2 hours and a maximum of 3 hours to First Additional Language in Grades R – 2. In Grade 3 a maximum of 8 hours and a minimum of 7 hours are allocated to Home Language and a minimum of 3 hours and a maximum of 4 hours to First Additional Language.

(d) To Life Skills Beginning Knowledge 1 hour is allocated in Grades R – 2 and 2 hours are allocated for Grade 3, as indicated by the hours in brackets.

1.4.2 Intermediate Phase

(a) The table below shows the subjects and instructional times **allocated to each** in the Intermediate Phase.

Subject	Time allocation per week (hours)
i. Home Language	6
ii. First Additional Language	5
iii. Mathematics	6
iv. Science and Technology	3.5
v. Social Sciences	3
vi. Life Skills	4
vii. Creative Arts	1.5
viii. Physical Education	1.5
ix. Religious Studies	1

1.4.3 Senior Phase

(b) The instructional time for each subject in the Senior Phase is allocated as follows:

Subject	Time allocation per week (hours)
i. Home Language	5
ii. First Additional Language	4
iii. Mathematics	4.5
iv. Natural Sciences	3
v. Social Sciences	3
vi. Technology	2
vii. Economic Management Sciences	2
viii. Life Orientation	2
ix. Arts and Culture	2

1.4.4 Grades 10 – 12

(a) The instructional time **for each subject** in Grades 10 – 12 is **allocated** as follows:

Subject	Time allocation per week (hours)
i. Home Language	4.5
ii. First Additional Language	4.5
iii. Mathematics (Technical Mathematics)	4.5
iv. Mathematical Literacy	4.5
v. Life Orientation	2
vi. Three Electives	12 (3x4h)

The allocated time per week may be utilised only for the **minimum number** of required NCS subjects as specified above, and may not be used for any additional **subjects added to the list of minimum subjects**. Should a learner wish to pursue additional subjects, additional time **has to** be allocated **in order to offer** these subjects.

SECTION 2

2.1 THE AIMS AND PURPOSE OF TECHNICAL SCIENCES

The main aim of Technical Sciences is to support learners in the three focus areas of technology, namely Mechanical Technology, Electrical Technology and Civil Technology. Learners will have an NQF level 4 competence in Technical Science.

Learners at Technical High Schools will be able to integrate scientific knowledge in a more informed way in their subject offerings in technology. Scientific concepts and skills will be more accessible to learners that have a technical orientation in schooling. Technical Sciences will address the needs of the industry and the technology subjects by being an enabling subject to promote technology study in schools.

Skills that learners will acquire include classifying, communicating, measuring, designing an investigation, drawing and evaluating conclusions, formulating models, hypothesizing, identifying and controlling variables, observing and comparing, interpreting, predicting, problem-solving and reflecting. The main skills will be practical application and observing simulations.

Technical Sciences will prepare learners for further education and training, employment, citizenship, holistic development and socio-economic development. Learners choosing Technical Sciences as a subject in Grades 10 – 12 will have improved access to applied technology courses, vocational career paths and entrepreneurial opportunity. Technical Sciences will also promote skills development in the fields of technology, thus promoting economic growth and social well-being of more citizens in our country.

The six main knowledge areas that Technical Sciences comprises of are:

- Mechanics
- Matter and Materials
- Electricity and Magnetism
- Waves, Sound and Light
- Heat and Thermodynamics
- Chemical Change

2.2 OVERVIEW OF TOPICS

TOPIC	CONTENT	
Mechanics	Grade10	**Units and measurements, Scientific notation, Working with formulae, Rate, Vectors and scalars** (Vectors, scalars, graphical representation of vectors), **Motion in one dimension:** (position, displacement, distance, speed, velocity, acceleration), **Introduction of Force** (Definition of force, contact force, non-contact force), **Kinds of forces** (Tension, normal force, force of gravity, frictional Force), **Force diagram and free body diagram, Resultant and Equilibrant, Equilibrium of forces in one dimension, Moment of a Force (Torque)** (Laws of moments), **Simple Machines** (Lever, fulcrum, types of levers, mechanical advantage), **Energy** (gravitational potential energy, kinetic energy, mechanical energy) (**53 hours**)
	Grade 11	**Introduction to Mechanics** (Sign conventions, graphs, Theorem of Pythagoras), Co-linear vectors, co-planar vectors, **Resultant of forces in two dimensions** (head-to-tail method, Theorem of Pythagoras, Parallelogram of forces), **Resolution of a forces into components, Frictional forces** (Static frictional force, Kinetic frictional force) (**32 hours**)
	Grade 12	**Newton's laws of motion** (Newton's First Law of motion, inertia, mass, acceleration, Newton's Second Law of motion, Newton's Third Law of motion), **Momentum** (Impulse and change in momentum), **Work energy and Power** (Work, Energy, Conservation of mechanical energy, Power, Power and velocity). **Elasticity** (Deforming force, restoring force, elasticity, perfectly elastic body, elastic limit, stress, strain, Hooke's Law,) **Viscosity** (effect of temperature on viscosity, motor oil viscosity grades), **Hydraulics** (Thrust, pressure, practical unit of pressure, fluid pressure, Pascal's Law, hydraulic lift) (**46 hours**)
Matter and Materials	Grade 10	**Classification of Matter** (Pure substances, elements, compounds, naming of compounds, cation and anion table, molecular formulae, balancing of equations), **Metals, Metalloids and Non-metals, Electrical conductors, semiconductors and insulators,** **Thermal conductors and insulators, Magnetic and non-magnetic, Structure of the atom** (Atomic Number, mass number, isotopes, The Periodic Table, electron configuration) (**31 hours**)
	Grade 12	**Electronic Properties of Matter** (Semiconductor, intrinsic semiconductor, doping, n-type semiconductor, p type semiconductor, p-n junction diode) (**4 hours**) **Organic chemistry** (Organic molecules, molecular and structural formulae, functional group, homologous series, saturated hydrocarbons, unsaturated hydrocarbons, isomers, IUPAC naming and formulae, physical properties of organic compounds, reactions of organic compounds, plastics and polymers) (**12 hours**)
Waves and Sound	Grade 11	**Pulses** (Transverse pulses, longitudinal pulses) **Waves** (Transverse wave, longitudinal wave), **Wave Terminology** (Amplitude, crest, trough, points in phase, wavelength, period, frequency, wave speed) **Superposition of waves** (constructive interference, destructive interference). **Sound waves** (Speed of sound in different media, reflection of sound, echo, pitch, loudness, range of sound frequencies) (**33 hours**)
	Grade 12	**Light** (Reflection of light, Refraction**,** Critical angle, total internal reflection, Dispersion, lenses) **Electromagnetic radiation** (Nature of Electromagnetic radiation**,** properties of electromagnetic radiation, electromagnetic spectrum, uses of electromagnetic radiation, photons, energy of a photon) (**12 hours**)

Electricity and Magnetism	Grade 10	**Electrostatics** (Two kinds of charge, charge conservation). **Electric circuits** (Components of a circuit, current, potential difference, emf, measurement of voltage and current), resistance, resistors in series, resistors in parallel) (**25 hours**)
	Grade 11	**Magnetism** (Magnets, the magnetic field, poles of permanent magnet, direction of magnetic field, magnetic field of a bar magnet, force a magnet, properties of magnetic field lines, earth's magnetic field) (**8 hours**) **Electrostatics** (Coulomb's Law, electric field, electric field lines, electric field between parallel plates, applications of electrostatics) (**10 hours**) **Electric circuits** (Ohm's Law, ohmic and non- ohmic conductors, circuit calculations, emf, internal resistance) (**17 hours**) (**Total = 35 hours**)
	Grade 12	**Electrostatics** (Capacitor, capacitance, factors affecting capacitance) **Electric circuits** (Power**,** heating effect of electric current) **Electromagnetism** (Magnetic effect of a current-carrying conductor, electromagnetic induction Faraday's Law, magnetic flux, magnetic flux density, Lenz's Law, transformer, generator, motor) (**28 hours**)
Heat and Thermodynamics	Grade 10	**Heat and Temperature** (Heat, temperature, different types of thermometers, Celsius scale, kelvin scale) (**6 hours**)
	Grade 11	**Heat** (Specific heat capacity and heat capacity, practical application of heat capacity, Law of conservation of heat) **Thermodynamics** (Terminologies, thermodynamic system, surrounding, open system, closed system, isolated system, thermodynamic variables or co-ordinates, internal energy of a thermodynamic system, first Law of Thermodynamics, working substance, heat engine, efficiency of heat engine, second law of thermodynamics, refrigerators) (**13 hours**)
Chemical Change	Grade 11	**Oxidation and reduction** (Oxidation, reduction, oxidizing agent, reducing agent, assigning oxidation numbers) **Electrolysis** (Electrolyte, cathode, anode) (**14 hours**)
	Grade 12	**Electrochemical cells** (Electrolytic cells, galvanic cells, components of galvanic cells, half reactions, net reaction, standard conditions, ionic movement, standard cell notation, emf of a cell) **Alternate Energies** (Biodiesel, fuel cells, photovoltaic cells) (**10 hours**)

2.3 OVERVIEW OF PRACTICAL WORK

Practical work must be integrated with theory to strengthen the concepts being taught. These may take the form of simple practical demonstrations or even an experiment or practical investigation. There are several practical activities given alongside the *content, concepts and skills* columns throughout **Section 3.** Some of these practical activities will be done as part of formal assessment and others can be done as part of informal assessment. Below is a table that lists prescribed practical activities for formal assessment as well as recommended practical activities for informal assessment across Grades 10 to 12.

Grade	Term	Prescribed Practical Activities Formal Assessment	Recommended Practical Activities Informal Assessment
Grade 10	Term 1	**Experiment (formal):** Use spring balances to demonstrate the resultant and equilibrant.	**Experiment:** Measure the velocity of a trolley. **Experiment:** Measure the weight of different objects using a spring balance.
	Term 2	**Experiment (formal):** Use a meter stick and mass pieces to prove the laws of moments. **Experiment (formal):** Determine the potential energy of an object at different heights.	**Experiment:** Determine the mechanical advantage of a type 1 lever.
	Term 3	**Project (formal):** Do a research project related to Technology. Example: Use of levers in Technology. **Experiment (formal):** Determine the electrical conductivity of different materials. 	**Experiment:** To investigate the insulation ability of polystyrene cup. **Experiment**: To determine whether a given material is magnetic or nonmagnetic. **Experiment:** To investigate the two kinds of charges. **Experiment:** Construct an electric circuit to measure current through a resistor and the voltage across a resistor; draw diagrams of the circuits.
	Term 4		**Experiment:** Investigate the factors that affect the resistance of a conductor. **Experiment:** Assemble a circuit to show that a series circuit is a voltage divider, while current remains constant. **Experiment:** Assemble a circuit to show that a parallel circuit is a current divider, while potential difference remains constant. **Experiment:** Measure the melting point of wax.

Grade	Term	Prescribed Practical Activities Formal Assessment	Recommended Practical Activities Informal Assessment
Grade 11	Term 1	**Experiments (formal):** Use the parallelogram of forces to: a) Determine the resultant of two forces acting a point. b) Determine the weight of given body.	**Experiment:** a) Determine the relation between the force of limiting friction and the normal force. b) Determine the coefficient of friction between a block and horizontal surface. **Experiment:** Determine the north pole of the earth by using a bar magnet. **Experiment:** a) Determine whether a material is a magnetic material or a magnet. b) Determine the polarity of the magnets. **Experiment**: Mapping a magnetic field.
	Term 2	**Experiment (formal):** a) Determine the speed of sound in air. b) Determine whether sound travels in a vacuum. **Experiment (formal):** Determine the difference between pitch and loudness using an oscilloscope.	**Experiment:** Use a ripple tank to demonstrate constructive and destructive interference of two pulses.
	Term 3	**Experiment (formal):** Determine the resistance of an unknown resistor. **Project:** Do a research project related to Technology. Example: Use of electrostatics in Technology.	**Experiment:** Obtain current and voltage data for a piece of copper wire and semi-conductor, and determine which obeys Ohm's law. **Experiment:** Determine the internal resistance of a battery. **Experiment:** Determine the heat capacity of a solid.
	Term 4		**Experiment:** Electrolysis of a salt solution.

Grade	Term	Prescribed Practical Activities Formal Assessment	Recommended Practical Activities Informal Assessment
Grade 12	Term 1	**Experiment (formal):** Determine the relationship between acceleration and force for a constant mass.	**Experiment:** Show that the action-reaction pairs cancel each other. **Experiment:** To determine if momentum is conserved during a collision. **Experiment:** Determine the power output of a learner.
	Term 2	**Experiment (formal):** Determine the path of a ray of light through a glass slab for different angles of incidence.	**Experiment:** Determine the position of an image in a flat mirror.
	Term 3	**Experiment (formal):** To determine the electrode potential of a Cu-Zn electrochemical cell.	**Experiment:** Determine the power dissipated in bulbs connected either in series or parallel or both in series and both in parallel. **Experiment:** Determine the current rating of a fuse. **Experiment:** Determine the effect of the change in magnetic field or magnetic flux in a coil. **Experiment:** Study the characteristics of p-n junction diode.
	Term 4		

2.4

2.5 WEIGHTING OF TOPICS [40 WEEK PROGRAMME]

TOPICS	GRADE 10	GRADE 11	GRADE 12
	%	%	%
Mechanics	46	25	47
Waves, sound and light	0	26	13
Electricity and magnetism	22	28	18
Matter and materials	27	0	13
Chemical change	0	11	10
Heat and thermodynamics	5	10	0

2.6 OVERVIEW OF FORMAL ASSESSMENT AND RECOMMENDED INFORMAL EXPERIMENTS

For Grades 10 and 11, FOUR prescribed experiments are done per year as formal assessment (one experiment per term for terms 1 to 4). For Grade 12, THREE prescribed experiments are done per year as formal assessment (one experiment per term for terms 1, 2 and 3). TWO control tests and TWO examinations are written as formal assessment in each of Grades 10 and 11. ONE control test, ONE midyear examination, ONE trial examination and ONE final examination are written as formal assessment for Grade 12.

ONLY in Grade 10 and Grade 11, ONE project is done per year as formal assessment or an integrated Chemistry/ Physics project (started in term 1 and assessed in term 3). Any ONE of the recommended projects can be done or any ONE of the experiments can be done as a practical investigation, or any other topic of choice can be used as a project. It is recommended that the project topic is given to learners early in the first term so that learners can start the project. The final assessment of the project is done and recorded in the third term. In Grade 12 **NO** project is done.

There are 11 informal experiments for Grade 10, nine recommended informal experiments for Grade 11 and nine recommended informal experiments for Grade 12.

SECTION 3

TECHNICAL SCIENCES CONTENT (GRADES 10 – 12)

TERM 1 GRADE 10			
MECHANICS			
Time	**Topic Grade 10**	**Content, Concepts & Skills**	**Guidelines for Teachers**
3 hrs	**Units and measurements**	• CGS units. • List seven fundamental units of SI system. • Derived units. • Prefixes. • Conversion of units: CGS units to SI units and vice versa. • Focus on conversion on units related to technology.	Focus on conversions within metric system to basic SI units. Focus on conversions from km to m and from h to s.
2 hrs	**Scientific notation**	• Use scientific notation to express number as a power. • Focus on examples using scientific notation related to technology.	
2 hrs	**Working with formulae**	• Identify the correct formula. • Substitute the given values into the formula. • Solve for the unknown quantity. • Develop examples to solve problems using equations from • Technology.	Reinforce the meaning of the symbols in the formula e.g. P-pressure, p-momentum V-volume, v-velocity
2 hrs	**Rate**	• Rate is the change in a physical quantity in unit time. • Give examples related to the concept of rate in technology.	Give additional examples related technology.
6 hrs	**Vectors and scalars** Vectors Scalars	• Define a vector quantity. • Define a scalar quantity. • Give examples of vectors and scalars. • Differentiate between vector and scalar quantities.	Test learner's knowledge in identifying vectors and scalars. Give examples from technology and IKS.

Time	Topic Grade 10	Content, Concepts & Skills	Guidelines for Teachers
	Graphical representation of vectors	• Represent vectors graphically. • Identify the properties of vectors: equal vectors, negative vectors, addition and subtraction of vectors. **N.B. Use one dimension applications only**. • Define resultant vector as: The resultant of two or more vectors is the single vector which can produce the same effect as the two or more vectors. • Find resultant of two or more vectors in different directions: (a) graphically use the **tail-to-head** method. (b) by calculation.	Maximum of four vectors.
6 hrs	**Motion in one dimension** Position Distance Displacement	• Define one dimensional motion as motion along a line either forward or backward. • Define position as location of an object relative to the origin. • Define distance as actual path length between two points. SI unit: m • Define displacement as the shortest path between two points in a particular direction. SI unit: m • Differentiate between displacement and distance.	Use conceptual examples to show that distance is a scalar and displacement is a vector.

Time	Topic Grade 10	Content, Concepts & Skills	Guidelines for Teachers
	Speed	• Define speed as the rate of change of distance. Speed = $\frac{\text{distance}}{\text{time}}$ SI unit: $m.s^{-1}$	
	Velocity	• Define velocity as rate of change of displacement. Velocity = $\frac{\text{displacement}}{\text{time}}$ SI unit: $m.s^{-1}$	
	Acceleration	• Define acceleration as the rate of change of velocity. Acceleration = $\frac{\text{change of velocity}}{\text{time}}$ SI unit: $m.s^{-2}$ • Do calculations using the above concepts.	
	Experiment 1	*Determine the velocity of a trolley* (Materials: Ticker timer, tape, power supply, trolley, ruler etc.)	
2 hrs	**Introduction of Force** Definition of force	• Define force as a push or a pull. SI unit of force is newton (N)	

Time	Topic Grade 10	Content, Concepts & Skills	Guidelines for Teachers
	Contact force Non-contact force	• In contact forces the interacting bodies must physically touch one another. • In non-contact forces the forces work over a distance without physically touching one another.	Identify some contact and non-contact forces.
2 hrs	**Kinds of forces** Tension Normal force Force of gravity Frictional Force **Experiment 2**	• Define tension as force acting in a string or rope. • Define normal force, F_N, as the perpendicular force exerted by a surface on an object that lies on that surface. • Define force of gravity, F_g , as the force of attraction exerted by the earth on an object. The force of gravity is also known as weight. $F_g = mg$. • It acts vertically downwards. • Differentiate between mass and weight. • Define frictional force, F_f, as the force parallel to the surface that opposes the motion of an object and acts in the direction opposite to the motion of the object. • *Measure the weight of different objects using a spring balance*. (Materials: Spring balances, mass pieces, etc)	Demonstrate the directions of each of the different forces. Discuss different ways to reduce friction using examples in technology.
4 hrs	**Force diagram and free body diagram** Force diagram Free body diagram	• A force diagram is the representation of all the forces acting on the object drawn as arrows. • In a free body diagram the object is replaced by a point with all the forces acting on it as arrows.	Give various situations for learners to draw the force diagrams and free body diagrams.
4 hrs	Resultant Equilibrant **Experiment 3 (Formal)**	• Define the resultant of two or more forces as the single force which can produce the same effect as two or more forces. • Define the equilibrant as the force that has the same magnitude as the resultant but acts in the opposite direction. • *Use spring balances to demonstrate the resultant and equilibrant are equal.* (Materials: Three spring balances, string, etc)	Give various situations for learners to calculate the resultant and equilibrant of a number of forces.
1 hr	Equilibrium of forces in one dimension	• A body is in equilibrium when the resultant force is zero.	

Time	Topic Grade 10	Content, Concepts & Skills	Guidelines for Teachers
		TERM 2 GRADE 10	
3 hrs	**Moment of a force (Torque)**	• Moment of a force about a point is defined as the turning effect of the force about that point. • It is measured as the product of the force and the perpendicular distance from the point to the line of action of the force. Torque = $F \times r_{\perp}$. SI unit: N.m • Use the formula to calculate torque.	Familiarise learners with the concept of torque in the field of technology.
5 hrs	**Laws of moments** **Experiment 4 (formal)**	• For a body in equilibrium the sum of the clockwise moments about a point must be equal to the sum of anticlockwise moments about the same point. • Do calculations to show that the clockwise moment is equal to the anti-clockwise moment. • *Use a meter stick and mass pieces to prove the laws of moments.* (Materials: Meter sticks, mass pieces, retort stand etc.)	
	Beams Beams Cantilever Simple supported beams Shear force Bending moments Conditions of equilibrium	• Define beam as a single rigid length of material supported horizontally to carry vertical loads. • Define cantilever as a beam where one end is fixed and one end is free to move. • Define a simple supported beam as a beam resting on two supports and the beam being free to bend under the action of the forces. • Shear force is the algebraic sum of all the external forces perpendicular to the beam on one side of that section. • Bending moment is the algebraic sum of all the moments of the forces on one side of that section. • A beam is in equilibrium if it is at rest and obeys the simple rules of equilibrium.	
4 hrs	**Simple Machines** Lever	• Define a lever as a simple machine. • Understand that machines are used to make work easier.	Use IKS to demonstrate how simple machines are made or used in daily life.

Time	Topic Grade 10	Content, Concepts & Skills	Guidelines for Teachers
	Fulcrum Types of levers Mechanical advantage **Experiment 5**	• Define a fulcrum as the turning point of the lever. (The lever rotates about this point) • Define type 1, type 2 and type 3 levers. • Identify different types of levers used in daily life. • Define mechanical advantage as the ratio of load to effort. MA= $\frac{L}{E} = \frac{e}{l}$ • Do calculations using the above formula. • Mechanical advantage has no unit. • *Determine the mechanical advantage of type 1 lever*. (Materials: Stick, mass pieces, knife edge etc).	Test learners' knowledge of levers
7 hrs	**Energy** Gravitational potential energy **Experiment 6**	• Define gravitational potential energy of an object as the energy it has because of its position from the surface of the earth. E_P = mgh or (U = mgh) • Do calculations using the above equation. • *Determine the potential energy of an object at different heights.* (Materials: 1 kg mass piece, meter stick, retort stand etc)	
	Kinetic energy Mechanical energy	• Define kinetic energy as the energy of an object due to its motion. $E_K = \frac{1}{2}mv^2$ or (K = $\frac{1}{2}mv^2$) • Do calculations using the above equation. • Define mechanical energy as the sum of the gravitational potential energy and kinetic energy. • Do calculations using the above equation.	

Time	Topic Grade 10	Content, Concepts & Skills	Guidelines for Teachers
		Matter and Materials	
20 hrs	**Classification of Matter**	• Revise the different properties of materials: Strength, thermal and electrical conductivity, brittle, malleable or ductile, magnetic or non-magnetic, density (lead/aluminium), melting points and boiling points.	
	Pure substances	• Define a pure substance as a single type of material (elements or compounds).	
	Elements	• Define an element as the simplest type of a pure substance.	
	Compounds	• Define a compound as a substance made up of two or more elements in the exact ratio. • Classify substances as pure, compounds or elements.	
	Naming of compounds	• Name compounds using the names of the elements from which they are made.	
	Cations and anions	• Define the terms cation and anion. • Identify cations and anions	
	Molecular formulae	• List the common compound anion, only sulphate, carbonate, sulphite, hydroxide • Use cations and anions to write formulae. • Write the name of a compound when a molecular formula is given. • Write the molecular formulae when given the names of compounds. • Use stock notation, like iron II oxide for example, to write formulae. • Write formulae for binary compounds like magnesium oxide. • Use suffixes like -ide, -ite and -ate to name compounds. • Use prefixes like di-, tri- etc to name compounds.	
	Balancing of equations	• Represent reactions in equations and balancing of equations. • Use suitable examples from technology, like the reaction in a catalytic convertor.	

Term 3			
Time	**Topic Grade 10**	**Content, Concepts & Skills**	**Guidelines for Teachers**
7 hrs	**Metals, Metalloids and Non-metals**	• Classify substances as metals, metalloids and non-metals using their properties. • Identify their positions on the Periodic Table. • Describe metalloids as having mainly non-metallic properties. • Revise the classification of materials as: electrical conductors, semiconductors and insulators.	
	Electrical conductors, semiconductors and insulators	• Give examples of electrical conductors, semiconductors and Insulators. • Identify the substances and the 'appliances or objects', which are in common daily use in homes and offices, that are specifically chosen because of their electrical properties (conductors, insulators and semiconductors).	
	Experiment 7	• *Determine the electrical conductivity of different materials*. (Materials: Battery, ammeter, connecting wires etc.)	
	Thermal conductors and insulators	• Classify materials as thermal conductors and insulators. • Give examples of materials that are thermal conductors and insulators.	
	Experiment 8 (Formal)	• *Test the insulation ability of polystyrene cups.* (Materials: Four polystyrene cups, scissors, 500 ml beaker, 2 thermometers, Bunsen burner, stop watch or clock etc.)	
	Magnetic and non-magnetic materials	• Classify materials as magnetic and non-magnetic. • Give examples of materials that are magnetic and non-magnetic. • Give examples of the use of magnets in our daily life.	
	Experiment 9	• *To determine whether a given material is magnetic or non-magnetic.* (Materials: Bar magnets, different types of metals and non-metals etc.)	
4 hrs	**Structure of the atom** Atomic Number	• Define the atomic number of an element as the number of protons in the atom.	
	Mass Number	• Define the mass number as the number of protons and neutrons in the atom.	
	Isotopes	• Define an isotope as atoms with the same atomic number but different mass number.	
	Periodic Table	• Introduce the periodic table. Use a **periodic table** to determine the number of: a) protons b) electrons c) neutrons in different elements.	
		• State the charge of a proton, neutron and electron	

Time	Topic Grade 10	Content, Concepts & Skills	Guidelines for Teachers
	Electron Configuration	• Give electronic arrangement of the first 20 elements in the periodic table using Aufbau principle (using (↑↓)) notation. • Order of filling in the different energy levels. • Differentiate between core electrons and valence electrons. • Give spectroscopic electron configuration of the first 20 elements in the periodic table using the notation ($1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$). • Determine the nuclear composition of some of the elements found in technology.	
Electricity			
Electrostatics			
3 hrs	Two kinds of charge	• Explain that all materials contain positive charges (protons) and negative charges (electrons). • Explain that an object which has an equal number of electrons and protons is neutral (no net charge). • Explain that positively charged objects are electron deficient and negatively charged objects have an excess of electrons. • Describe how objects (insulators) can be charged by contact (or rubbing).	
	Experiment 10	• *Investigate the two kinds of charges*. • Use any of the following: 1. A Perspex rod, a Polythene rod, a woollen cloth, small pieces of paper. 2. Van der Graaf generator. 3. Gold leaf electroscope.	
4 hrs	Charge conservation	• The principle of conservation of charge states that the net charge of an isolated system remains constant during any physical process. • Apply the principle of conservation of charge. • Determine the charge of two objects after they touch and separate using: $Q = \frac{Q_1 + Q_2}{2}$ • Use the above equation to solve problems involving charges. **NOTE:** This equation is only true for identical conductors.	Give various situations to calculate the charge when two charges touch and separate.
4 hrs	**Electric circuits** Components of a circuit	• Draw the components of a circuit using appropriate circuit symbols. • Give the meanings of all symbols used.	Practice drawing circuits using circuit symbols.

Time	Topic Grade 10	Content, Concepts & Skills	Guidelines for Teachers
	Current	• Define current, I, as the rate of flow of charge. It is measured in Ampere (A), which is the same as Coulomb per second. • Calculate the current flowing using the equation $I = \frac{Q}{\Delta t}$ • Indicate the direction of the current in circuit diagrams (conventional).	
	Potential difference (terminal pd)	• Define potential difference in terms of work done and charge. $V = \frac{W}{Q}$	Measure the emf and potential difference of a cell.
	Emf	• Emf is the potential difference across the cell when no current is flowing in the circuit (open circuit). • Give the difference between emf and potential difference. • emf and pd are measured in volts (V). • Do calculations using the above equations.	
3 hrs	Measurement of voltage (pd)and current **Experiment 11**	• Draw diagrams to show how to measure voltage and current in a circuit. • *Build an electric circuit to measure current through a resistor and to measure the voltage across a resistor; draw diagram of the circuit.* (Materials: Conducting wire, cells, Voltmeter, resistor, Ammeter, Switch etc.)	

Term 4			
Electricity			
Time	**Topic Grade 10**	**Content, Concepts & Skills**	**Guidelines for Teachers**
3 hrs	Resistance **Experiment 12**	• Resistance is defined as the opposition to the flow of electric Current. • 1 Ω = 1 V.A^{-1}. • Give a microscopic description of resistance in terms of electrons moving through a conductor and colliding with the particles of which the conductor (metal) is made and thereby transferring kinetic energy. • State and explain factors that affect the resistance of a substance. • *Investigate the following factors that affect the resistance of a conductor:* • *Temperature* • *Thickness* • *Length* • *Type of materials* (Materials: Copper and nichrome wires of different thicknesses, Cells, Voltmeter, Ammeter, switch etc.)	
4 hrs	Resistors in series	• Resistors are in series when they are connected end to end such that the current has only one path through each resistor. $R_s = R_1 + R_2 + R_3$ • The same current flows through each resistor. $I_T = I_1 = I_2 = I_3$ • Series circuits are called potential dividers. $V_T = V_1 + V_2 + V_3$	

Time	Topic Grade 10	Content, Concepts & Skills	Guidelines for Teachers
	Experiment 13	• *Set up a circuit to show that series circuits are voltage dividers, while current remains constant.* (Materials**:** Light bulbs or resistors, batteries, switches, connecting leads, ammeters, voltmeters etc.)	Remind learners that as you add more resistors in series resistance increases.
4 hrs	Resistors in parallel	• Resistors are in parallel when they are connected to the same point such that the current has different paths through each resistor. $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ • Alternatively, when we have two resistors in parallel we can use the formula $R_P = \frac{R_1 R_2}{R_1 + R_2}$ • Voltage is constant across each resistor, connected in parallel. $V_T = V_1 = V_2 = V_3$ • Resistors in parallel are current dividers. $I_T = I_1 + I_2 + I_3$	Remind learners that as you add more resistors in parallel resistance decreases.
	Experiment 14 (Formal)	• *Set up a circuit to show that parallel circuits are current dividers, while potential difference remains constant.* (Materials: Light bulbs or resistors, batteries, switches, connecting leads, ammeters, voltmeters etc.)	

Heat and Thermodynamics			
Time	**Topic Grade 10**	**Content, Concepts & Skills**	**Guidelines for Teachers**
1 hr	**Heat and Temperature** Heat Temperature	• Define heat as a form of energy. SI unit of heat is joule (J). • Temperature is an indication of how hot or cold a body is. SI unit of temperature is kelvin (K). • Temperature is measured with a thermometer in degree Celsius ().	
2 hrs	Different types of thermometers	• Alcohol thermometer, Mercury thermometer, Thermoelectric thermometer. • Give the application of thermometers in technology.	Use a mercury thermometer to measure the temperature of the following substances: (a) ice water (b) tap water (c) boiling water.
3 hrs	Celsius scale Kelvin scale	• Celsius scale is used to measure temperature for general purposes. • The Kelvin scale is used for thermodynamical calculations.	Fahrenheit (not for assessment but for enrichment only).
	     Experiment 15	**T = t+273** **T** is the temperature in kelvin. **t** is the temperature in degree Celsius. • Use the above equation to convert temperature from Celsius to Kelvin. • *Measure the melting point of wax.* (Materials: Paraffin wax, Bunsen burner, Thermometer, 500 ml beaker, boiling tube, clamps, etc.)	

TERM 1 GRADE 11			
MECHANICS			
Time	**Topics Grade 11**	**Content, Concepts & Skills**	**Guidelines for Teachers**
4 hrs	Introduction to Mechanics Sign conventions	• Use the Cartesian coordinates system to indicate the directions (+ve X and +ve Y as positive). • Use compass directions to indicate the directions. • Express the direction using bearing by measuring on the north line in the clockwise direction to the vector. • Use the above methods to determine the directions of vectors.	Recall that vectors have magnitude and direction.
4 hrs	Graphs	• Demonstrate the direct proportion graphs in the context of technology. • Demonstrate the indirect proportion graphs in the context of technology.	Recall that straight line graphs are represented by y = mx+c and hyperbolic graphs are represented by xy = k.
2 hrs	Theorem of Pythagoras	• Determine the resultant of two vectors acting perpendicular to each other using the theorem of Pythagoras: $F_R^2 = F_1^2 + F_2^2$ • Use the theorem of Pythagoras to calculate the resultant of forces, in the context of technology.	Recall theorem of Pythagoras.
Time	**Topics Grade 11**	**Content, Concepts & Skills**	**Guidelines for Teachers**
2 hrs	Co-linear vectors Co-planar vectors	• Define co-linear vectors as vectors that have the same line of action. • Define co-planar vectors as vectors that are in the same plane. • Draw the resultant of two co-linear vectors.	

Time	Topics Grade 11	Content, Concepts & Skills	Guidelines for Teachers
8 hrs	**Resultant of forces in two dimensions.** Head-to-tail method Theorem of Pythagoras Parallelogram law of forces	• Use the head-to-tail method to determine the resultant of two vectors at right angles to each other. • Use the theorem of Pythagoras to determine the resultant of forces acting at right angles to each other. • The Parallelogram law of forces states that if two forces acting at a point can be represented by the adjacent sides of a parallelogram both in magnitude and direction, then the diagonal from the point gives the resultant of the two forces. • Use the parallelogram law to determine the resultant of two forces acting at an angle to each other. • Using scale drawing (Do not do calculations involving the resultant.)	Recall the resultant of forces.
	Experiment 1 (formal)	• *Use the parallelogram of forces to:* a) Determine the resultant of two forces acting on a point. b) Determine the weight of a given body. (Materials: Force board with two pulleys, mass pieces, pins, sheet of paper, light strings etc.)	
6 hrs	**Resolution of forces into components**	• Given a force F acting at an angle to the horizontal axis, resolve the force into its parallel and perpendicular components (Rectangular components).	Do scale drawing and calculations.
6 hrs	**Frictional forces** Static frictional force Kinetic frictional force **Experiment 2**	• Define frictional force as the force that opposes the motion of an object. • The static (limiting) frictional force acts between the two surfaces when the object is stationary. It is given by $f_s = \mu_s F_N$ • The kinetic (dynamic) frictional force acts between the two surfaces when the object is moving. It is given by $f_k = \mu_k F_N$ • Use the above equation to solve problems involving frictional forces. (No inclined plane problems) *a) Determine the relation between the force of limiting friction and the normal force.* *b) Determine the coefficient of friction between a block and horizontal surface.* (Materials: A wooden block, a set of 50 gram weights, weight box, pan, horizontal table fitted with a pulley etc.)	Recall the normal force.

Magnetism and Electricity			
Time	**Topics Grade 11**	**Content, Concepts & Skills**	**Guidelines for Teachers**
8 hrs	Magnet The magnetic field Poles of permanent magnet Direction of magnetic field Magnetic field of a bar magnet Force of a magnet Properties of magnetic field lines **Experiment 3**	• Describe a magnet as an object that has a pair of opposite poles, called north and south. Even if the object is cut into tiny pieces, each piece will still have both a N and a S pole. • Define the magnetic field as the region in space where another • magnet or ferromagnetic material will experience a force. • Like magnetic poles repel each other and opposite poles attract each other. • Use a compass to determine the direction of the magnetic field. • Sketch the magnetic field of a bar magnet. • Predict the behaviour of magnets when they are brought close together. • Discuss the properties of magnetic field lines. • *Determine the north pole of the earth using a bar magnet.* (Materials: Bar magnet, string, wooden stand, etc.)	Give examples of magnets relevant to technology.
	Experiment 4 **Experiment 5** Earth's magnetic field	a) *Determine whether a material is a magnetic material or a magnet.* b) *Determine the polarity of the magnets.* (Materials: Bar magnets, magnetic material, string, wooden stand, etc.) • *Mapping of magnetic field.* (Materials: Bar magnet, compass needle, drawing board, paper, pin, etc.) • Compare the magnetic field of the earth to the magnetic field of a bar magnet. • Explain the difference between the geographical North pole and the magnetic North pole of the earth. • Give examples of phenomena that are affected by earth's magnetic field e.g. Aurora Borealis (Northern Lights) & magnetic storms. • Discuss qualitatively how the earth's magnetic field provides protection from solar winds.	

TERM 2 GRADE 11			
WAVES AND SOUND			
Time	**Topics Grade 11**	**Content, Concepts & Skills**	**Guidelines for Teachers**
4 hrs	**Pulses** Transverse pulses Longitudinal pulses **Experiment 6**	• Define a pulse as a single disturbance in a medium. • Define a transverse pulse as a pulse in which the particles of the medium vibrate at right angles to the direction of propagation of the pulse. • Define a longitudinal pulse as a pulse in which the particles of the medium vibrate parallel to the direction of propagation of the pulse. • *Observe the motion of a single pulse travelling along a long, soft spring or a heavy rope.* (Materials: Slinky spring, rope etc.)	
3 hrs	**Waves** Transverse wave Longitudinal wave	• Define a wave as a succession of pulses. • Define a transverse wave as a wave in which the particles of the medium vibrate at right angles to the direction of propagation of the wave. • Draw the transverse. • Define a longitudinal wave as a wave in which the particles of the medium vibrate parallel to the direction of propagation of the wave. • Draw the longitudinal wave.	
8 hrs	**Wave Terminology** Amplitude Crest Trough Points in phase Wavelength Period Frequency Relationship between period and frequency	• Define amplitude as the maximum displacement of a particle from its rest (equilibrium) position. • Define a crest as the uppermost point on a transverse wave. • Define a trough as the lowermost point on a transverse wave. • Define points in phase as any two points that are in the same state of vibration. • Define wavelength (as the distance between two successive points in phase. SI unit: m • Draw and label transverse and longitudinal waves. • Define the period (T) as the time taken to complete one wave. SI unit: s • Define frequency (f) as the number of waves per second. SI unit: hertz (Hz) Note: 1 Hz = 1 s^{-1} • $T=\frac{1}{f}$ • Use the above equation to solve problems involving period and frequency in the content of technology.	

Time	Topics Grade 11	Content, Concepts & Skills	Guidelines for Teachers
	Wave speed	• Define wave speed as the distance travelled by the wave in one second. $v = \frac{\text{distance travelled}}{\text{time taken}}$ or $v = \frac{\lambda}{T}$ or $v = f\lambda$ • Use the above equations to solve problems involving speed, wavelength and frequency, distance, time, in the content of technology.	
5 hrs	**Superposition of waves** Constructive interference Destructive interference **Experiment 7**	• Define the superposition as the algebraic sum of the amplitudes of the waves that meet at the same point simultaneously. • Define constructive interference as the superposition of the two waves which are in phase. • Define destructive interference as the superposition of the two waves which are out of phase. • Demonstrate the phenomenon of constructive and destructive interference using transverse wave pulses. • *Use a ripple tank to demonstrate constructive and destructive interference of two pulses.* (Materials: Ripple tank apparatus)	

Time	Topics Grade 11	Content, Concepts & Skills	Guidelines for Teachers
8 hrs	**Sound waves** Speed of sound in different media Reflection of sound Echo **Experiment 8 (formal)**	• Sound waves are longitudinal waves. • Investigate the speed of sound waves in different mediums (gas, liquid or solid). • • Define the reflection of sound waves as the bouncing back of the wave from a surface. • Define an echo as the reflection of a sound wave. • *Determine the speed of sound in air.* (Materials: Tuning forks, rubber hammer, meter stick, etc.)	**Demonstration:** Make sound using a vuvuzela, string, tuning-fork, loud-speaker, drum-head. **Demonstrate** that sound needs a material medium (air) to propagate.
4 hrs	Pitch Loudness Range of sound frequencies **Experiment 9 (formal)**	• Define pitch as a measure of how high or low a note is. • Frequency of sound determines its pitch. The higher the frequency, the higher the pitch. • Loudness is determined by the amplitude of the sound. • The higher the amplitude, the louder sound. • Use wave patterns to demonstrate pitch and loudness. • Infrasound: frequencies less than 20 Hz. • Audible sound: frequencies from 20 Hz to 20 000 Hz. • Ultrasound: frequencies greater than 20 000Hz. • Application of infrasound and ultrasound related to technology. • *Determine the difference between pitch and loudness using an oscilloscope.* (Materials: Oscilloscope, function generator, loud-speaker, etc)	

TERM 3 GRADE 11			
Electricity and Magnetism			
Electrostatics			
Time	**Topics Grade 11**	**Content, Concepts & Skills**	**Guidelines for Teachers**
4 hrs	**Coulomb's Law**	• Coulomb's Law states that the force of attraction or repulsion between two point charges is directly proportional to the product of their charges and inversely proportional to the square of the distance between the two charges. $F = \frac{kQ_1Q_2}{r^2}$ • Use the above equation to calculate the force and charge.	
6 hrs	**Electric field** Electric field lines	• Define the electric field as a region of space in which an electric charge experiences a force. $E = \frac{F}{Q}$ • Use the above equation to calculate the force, charge and electric field. • The direction of the electric field at a point is the direction that a positive test charge (+1C) would move if placed at that point. • Draw electric field lines: (a) Around a positive charge (b) Around a negative charge (c) Between a positive and a positive charge (d) Between a negative and a negative charge (e) Between a positive and a negative charge.	

Time	Topics Grade 11	Content, Concepts & Skills	Guidelines for Teachers
	Electric field between parallel plates Applications of electrostatics	• Electric field between parallel plates. $E = \frac{V}{d}$ • Do calculation by using the above equation. • Discuss the relationship between E, V and d. • Draw electric lines between two parallel plates. • Discuss application of electrostatics related to technology.	
Electric circuits			
8 hrs	Ohm's Law **Experiment 10 (formal)** Ohmic and non- Ohmic conductors	• Ohm's law states that the current in a conductor is directly proportional to the potential difference across it, at constant temperature. V= IR • Use the above equation to do calculations (include graphical calculations). • *Determine the resistance of an unknown resistor.* (Materials: Battery, ammeter, voltmeter, a resistance wire, Rheostat, key, connecting wires etc.) • Any conductor that obeys Ohm's law is called an Ohmic conductor. • Give examples of Ohmic conductors. • A conductor that does not obey Ohm's law is called non-Ohmic conductor. • Give examples of non-Ohmic conductors.	
	Experiment 11	• *Obtain current and voltage data for a piece of copper wire and semi-conductor and determine which one obeys Ohm's law.* (Materials: Copper wire, semiconductor connecting wires, ammeter and voltmeter etc.)	
6 hrs	Circuit calculations Emf	• Use series and parallel resistors in combination with Ohm's law. • Emf is defined as the potential difference across a cell when the circuit is open.	
3 hrs	Internal resistance **Experiment 12**	• Internal resistance is defined as the resistance inside the cell when current flows through it. (No calculation needed) • *Determine the internal resistance of a battery.* (Materials: Battery, multimeter, connecting wires, switch, etc.)	

Time	Topics Grade 11	Content, Concepts & Skills	Guidelines for Teachers
		Heat and Thermodynamics	
4 hrs	**Heat** Specific heat capacity Heat capacity	• Define the specific capacity (c) of a substance as the amount of heat required to increase the temperature of 1 kg of the substance by 1°C or 1K. **SI unit:** $\mathrm{Jkg^{-1}K^{-1}}$ • Define the heat capacity (C) of a substance as the amount of heat required to increase the temperature of the whole substance by 1or 1 K. **SI unit:** $\mathrm{JK^{-1}}$ • C = cm where m is the mass of a substance.	
	Practical application of heat capacity	• Use the above equation to do calculations. • Discuss practical application of heat capacity in technology.	
4 hrs	Law of conservation of heat **Experiment 13**	• Law of conservation of heat states that the amount of heat lost equals the amount of heat gained, when no heat is lost. • Amount of heat lost or gained is given by: Q = mcΔt SI unit of specific heat capacity: $Jkg^{-1}K^{-1}$. • Do calculations using the above equation. • *Determine the heat capacity of a solid.* (Materials: Calorimeter, thermometer, balance, lead or sand, water etc.)	Determine heat capacity of a liquid. (Informal)
5 hrs	**Thermodynamics** Terminologies Thermodynamic system Surrounding Open system	• In thermodynamics we deal with the processes involving heat, work and energy. • Define thermodynamic system as a portion of matter. E.g. Gas enclosed inside a cylinder, fitted with a piston. • Define the surrounding as anything outside the system which has some bearing on the behaviour of the system. • Define an open system as a system which can exchange matter and energy with the surroundings.	

Time	Topics Grade 11	Content, Concepts & Skills	Guidelines for Teachers
	Closed system Isolated system Thermodynamic variables or co-ordinates Internal energy of a thermodynamic system. First Law of Thermodynamics Working substance Heat Engine	• Define a closed system as a system which can exchange energy only, not matter, with the surroundings. • Define an isolated system as a system which is not influenced by its surroundings. (No exchange of heat or energy with the surroundings). • The thermal state of a system is defined by its temperature (T), pressure (P) and volume (V). These quantities are called thermodynamic variables. • Define internal energy of a thermodynamic system as the sum of the kinetic and potential energies of all the molecules of the system. • The first law of thermodynamics states that if heat energy ΔQ is given to a system, it is used in two ways: (i) In increasing the internal energy of the system (ΔU) (ii) In doing work against external pressure. (ΔW). • $\Delta Q = \Delta U + \Delta W$ • Use the above equation to calculate the internal energy, work done and the amount of heat supplied. • Define working substance as the substance that absorbs heat fromthe source. E.g. Air in petrol and diesel engines. • Define heat engine as a device which converts heat energy into mechanical work.	
	Efficiency of heat engine Second law of thermodynamics Refrigerators	• It absorbs heat from a ***hot body (source)***, converts a part of it into work and rejects the rest to a ***cold body (sink***). Efficiency, $= \frac{\text{Heat converted to work}}{\text{Total heat absorbed}} = \frac{W}{Q_1} = \frac{Q_1 - Q_2}{Q_1}$ (No calculation on efficiency of a heat engine). • It is impossible to get a continuous supply of work from a body by cooling it to a temperature lower than the lowest of its surroundings. • It is the reverse of a heat engine. • The working substance (coolant e.g. liquid ammonia, Freon etc.) absorbs heat from a cold body (freezer), with the help of an external agency (compressor), and rejects it to the hot body (atmosphere).	

TERM 4 GRADE 11			
Chemical Change			
Time	**Topics Grade 11**	**Content, Concepts & Skills**	**Guidelines for Teachers**
8 hrs	**Oxidation and Reduction** Oxidation Reduction	• Oxidation is defined as the loss of electrons. • Give examples of oxidation. • Reduction is defined as the gain of electrons. • Give examples of reduction.	
6 hrs	Oxidizing Agent Reducing Agent Assigning Oxidation Numbers **Electrolysis** Cathode Anode **Experiment 15**	• An oxidizing agent is defined as a substance that undergoes reduction. • A reducing agent is defined as a substance that undergoes oxidation. • Rules for assigning oxidation numbers. • Assign oxidation numbers in various molecules. • Electrolysis is the decomposition of a substance when an electric current is passed through it. • Cathode is the electrode where reduction takes place. • Anode is the electrode where oxidation takes place. • *Electrolysis of a salt solution.* (Materials: Carbon electrodes, beaker, copper chloride, water, power source, connecting wires, switch, etc.)	

TERM 1 GRADE 12			
MECHANICS			
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Guidelines for Teachers**
13 hrs	**Newton's Laws of motion**		
	Newton's First Law of Motion	• State Newton's first law: An object continues in a state of rest oruniform (moving with constant) velocity unless it is acted upon by an unbalanced (net or resultant) force.	
	Inertia	• Define inertia as the property of a body to resist any change in its state of motion or rest.	
	Mass	• Define mass as a measure of the inertia of a body. SI unit is kg.	
		• Give examples to illustrate Newton's first law.	
	Acceleration	• Define acceleration as the rate of change of velocity. SI unit is $m.s^{-2}$	
	Newton's Second Law of Motion	• State Newton's second law: When a net force, F_{net}, is applied to an object of mass, m, it accelerates the object in the direction of the net force. $F_{net} = ma$ SI unit is N.	Recall vector and scalars.
		• Use the above equations to solve problems involving force, massand acceleration in the content of technology. (Do not include pulley problems and lift problems).	
	Experiment 1 (formal)	• *Determine the relation between acceleration and force for a constant mass.* (Materials: Mass pieces, Trolleys, string, ticker timer, etc.)	
	Newton's Third Law of Motion	• State Newton's third law: When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A.	
		• Give examples to illustrate Newton's third law, using action-reaction pairs.	
	Experiment 2	• *Show that the action-reaction pairs are equal in magnitude and opposite in direction*. (Materials: Two spring balances, mass pieces, etc).	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
12 hrs	**Momentum**	• Momentum is defined as the product of mass and velocity. p = mv SI unit is $kg.m.s^{-1}$ • Use the above equations to solve problems involving momentum, mass and velocity, in the content of technology.	Discuss examples of impulse in our everyday lives.
	Impulse and change in momentum	• Impulse is the effect of large force acting on a body for a small interval of time. • Impulse is defined as the change in momentum. Impulse= $F\Delta t$ SI unit is N.s • $F\Delta t = \Delta p$	
	Conservation of momentum **Experiment 3**	• Use the above equations of impulse to solve problems involving force, time and change in momentum in the content of technology. • Force is defined as the rate of change in momentum. $F = \frac{\Delta p}{\Delta t}$ • Give examples of applications of impulse and momentum in the context of road safety. • The law of conservation of momentum states that the total linear momentum of an isolated system remains constant in magnitude and direction. • Explain the concepts elastic and inelastic collision. • Use the conservation of momentum to solve problems involving momentum, in the content of technology. • *To determine if momentum is conserved during a collision.* (Materials: Retort stand, string, brick, ticker timer, trolley etc.)	
10 hrs	**Work energy and Power** Work	• Define work as the product of the force applied on an object and the displacement in the direction of force. $W=F\Delta x\cos\theta$ • Use the above equation to solve problems involving work, force and displacement.	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
		• If a force and the displacement are at an angle to each other: W=F$\Delta x \cos\theta$ • Work is a scalar quantity. SI unit: joule (J)	
	Energy	• Explain that no work is done when a force acts at right angles to the direction of motion. • Define energy as the ability to do work.	
	Conservation of mechanical energy	• It is a scalar quantity. SI unit: joule (J) • The conservation of mechanical energy states that the total energy of an isolated system is constant.	
		• $M_E = E_k + E_p$ • Use the above equation to solve problems involving kinetic energy, potential energy and velocity in one dimension only.	
	Power	• Define power as the rate at which work is done. $P = \frac{W}{t}$ SI unit: watt (W) • Practical units of power in technology: (i) kW = 1000 W (ii) Horse power (hp) = 746W • Solve problems involving work, power and time, with the emphasis on conversions of the practical units.	
	Power and velocity	• When an object travels at a constant velocity we use: P = Fv. • Solve problems involving power, force and velocity with the emphasis on conversions of the practical units.	
	Experiment 4	• *Determine the power output of an individual.* (Materials: Sturdy wooden box to step on, meter stick, stop watch, bathroom scale etc).	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
6 hrs	**Elasticity**		
	Deforming force	• A force which changes the shape and size of a body is called a deforming force. • The force developed inside the body which tries to bring the body back into its initial size and shape.	
	Restoring force	• The restoring force is equal and opposite to the deforming force applied.	
	Elasticity	• Elasticity of a body is the property of the body by virtue of which the body regains its original shape and size when the deforming force is removed.	
	Perfectly elastic body	• A body which regains its original shape and size completely when the deforming force is removed is called a perfectly elastic body. • Give examples of perfectly elastic bodies.	
	Perfectly plastic body	• A body which does not show a tendency to regain its original shape and size when the deforming force is removed. • Give examples of perfectly plastic bodies.	
	Elastic limit	• The maximum force that can be applied to body so that the body regains its original form completely on removal of the force.	
	Stress	• The internal restoring force per unit area of body is called stress. $\sigma = \frac{F}{A}$ SI unit: Pa or $N.m^{-2}$ • Use the above equation to calculate stress, force and area or diameter.	
	Strain	• Define strain as the ratio of change in dimension to the original dimension. $\varepsilon = \frac{\Delta l}{L}$ • Strain does not have any unit.	

TERM 2 GRADE 12			
Elasticity			
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Guidelines for Teachers**
	Hooke's law	• Hooke's law states that, within the limit of elasticity, stress is directly proportional to strain. stress∝strain $\therefore \frac{\sigma}{\varepsilon}$ =K; a constant known as modulus of elasticity of the material of the body. Unit: Nm^{-2} or Pa • Use the above equation to calculate stress, strain and Modulus of elasticity.	
1 hr	**Viscosity** The effect of temperature on viscosity Motor oil viscosity grades	• Define viscosity as the property of the fluid to oppose relative motion between the two adjacent layers. • Discuss the effect of temperature *on viscosity in the field of technology.* • Discuss motor oil viscosity grades.	
5 hrs	**Hydraulics** Thrust	• Hydraulics (fluid mechanics) is a topic in applied science and engineering dealing with mechanical properties of liquids. • Define thrust as the normal force exerted by a liquid at rest on a given surface in contact with it.	
	Pressure Practical unit of pressure Fluid pressure Pascal's law Hydraulic lift	• Pressure at a particular point is the thrust acting on the unit area around that point. Pressure = $\frac{\text{Thrust}}{\text{area}} = \frac{F}{A}$ SI unit: Nm^{-2} or Pascal (Pa) • Use the above equation to calculate pressure, thrust and area. (i) atmosphere (atm) = $1{,}0110^5$ Pa (ii) bar: 1 bar = 10^5 Pa (iii) torr: 1 torr = 133 Pa • Fluid pressure is given by the following equation: P=ρgh • Use the above equation to calculate fluid pressure, height and density. • Pascal's law states that in a continuous liquid at equilibrium, the pressure applied at any point is transmitted equally to other parts of the liquid. • Hydraulic lift is used to lift heavy loads. • Discuss the use of hydraulics in technology. Examples: car lifts and jacks, hydraulic brakes, dentist chairs etc. • In hydraulic lifts: $\frac{F_1}{A_1} = \frac{F_2}{A_2}$ Where $A_2 > A_1$ • Use the above equation to calculate force, area and radius of the pistons.	

Matter and Materials			
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Guidelines for Teachers**
4 hrs	**Electronic Properties of Matter**	• A semiconductor is a material which has electrical conductivity between that of a conductor and an insulator such as glass.	
	Semiconductor	• Explain semiconductor with an example. (No energy band theory).	
	Intrinsic Semiconductor	• An intrinsic semiconductor is a pure semiconductor.	
	Doping	• Doping is the process of adding impurities to intrinsic semiconductors.	
	n-type semiconductor	• Discuss n-type semiconductor.	
	p type semiconductor	• Discuss p-type semiconductor.	
	p-n junction diode	• Discuss the construction and working of a p-n junction diode.	
	Experiment 5	• *Study the characteristics of p-n junction diode.* (Materials: Semiconductor diode, Voltmeter, milliammeter, Rheostat, switch, battery connecting wires etc.)	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
12 hrs	**Organic Chemistry**		
	Organic molecules	• Define organic molecules as molecules containing carbon atoms.	
	Molecular and structural formulae	• Write molecular formulae and structural formulae for organiccompounds of up to **six carbon atoms** for alkanes, alkenes, alkynes, alkylhalides, aldehydes, ketones, alcohols, carboxylic acids and esters.	
	Functional group	• Define functional group as an atom or group of atoms that determine the chemistry of a molecule.	
	Homologous series	• Define homologous series as a series of compounds that have the same general formula and where each member differs from the next by $-CH_2$.	
		• Distinguish between different homologous series.	
	Saturated hydrocarbons	• Saturated hydrocarbons contain only single covalent bonds between the carbon atoms.	
	Unsaturated hydrocarbons	• Unsaturated hydrocarbons contain covalent double or triple bonds between the carbon atoms.	
		• Distinguish between saturated and unsaturated homologous series.	
	Isomers	• Organic molecules with the same molecular formula but with different structures are called isomers.	
		• Write structural formulae for given isomers and name the isomers.	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
	IUPAC naming and formulae	• Give the IUPAC name when given the formula for alkanes, alkenes, alkynes, alkylhalides, aldehydes, ketones, alcohols, carboxylic acids and esters. • Give the formula when given the IUPAC name for alkanes, alkenes, alkynes, alkylhalides, aldehydes, ketones, alcohols, carboxylic acids and esters.	
	Physical properties of organic compounds	• Discuss physical property relationships (boiling point, melting point, vapour pressure and viscosity) in alkanes, alkenes, alkynes, alkylhalides, aldehydes, ketones, alcohols, carboxylic acids and esters. • Compare physical properties of different homologous series.	
	Reactions of organic compounds	• Oxidation • Substitution • Addition • Halogenations • Hydrohalogenation • Balance equations for the above reactions using molecular and structural formulae.	
	Plastics and polymers	• Describe the terms polymer, macromolecule, chains and monomers. • Define plastics and polymers. • Discuss the industrial use of polythene as a basic application of organic chemistry.	

Waves and Sound			
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Guidelines for Teachers**
12 hrs	**Light**		
	Reflection of light	• Discuss the laws of reflection.	
	Experiment 6	• *Determine the position of an image in a flat mirror*. (Materials: Flat mirror, Paper, drawing board pins, ruler etc.)	
	Refraction	• Define refraction as the bending of light when it passes from one medium to another. • Discuss the laws of refraction.	
	Experiment 7 (formal)	• *Determine the path of a ray through a glass slab for different angles of incidence*. (Materials: Rectangular glass slab, pins/ray box, white paper, Protractor, etc.)	Demonstrate the total internal reflection of light using semi-circular glass (Perspex box), protector, paper, ruler, ray box etc.
	Critical angle	• Define the critical angle as the angle of incident in the denser medium such that the refracted ray just passes through the surface of separation of the two media.	
	Total internal reflection	• When the angle of incidence is greater than the critical angle, the ray of light reflects into the original medium. • Discuss the conditions of total internal reflection. • Give uses of total internal reflecting prisms.	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
	Dispersion	• Define the dispersion of light as the phenomenon whereby white light breaks up into its component colours.	Show that white light undergoes dispersion when it passes through a triangular prism (Ray box, triangular prism, etc).
	Lenses	• Discuss frequency and wavelength of the various components of light.	
		• Discuss the transmission of light through convex and concave lenses.	
		• Discuss applications of convex and concave lenses.	
	Electromagnetic radiation		
	Nature of electromagnetic radiation	• Define an electromagnetic wave as a changing magnetic and electric field mutually perpendicular to each other and the direction of propagation of the wave.	
	Properties of electromagnetic radiation	• Discuss the properties of electromagnetic waves.	
	Electromagnetic spectrum	• Discuss the electromagnetic spectrum in terms of frequency and wavelength.	
	Uses of electromagnetic radiation	• Give the uses of electromagnetic radiation.	
	Photons	• Describe a photon of light as a quantum of energy.	
	Energy of a photon	• Energy of a photon of light is given by E = hf.	
		• Use the above equation to do calculations involving energy, frequency and wavelength of light.	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
		TERM 3 GRADE 12	
Electricity and Magnetism			
6 hrs	**Electrostatics** Capacitor Capacitance	• Define a capacitor as a device for storing electrical charge. • Give examples of capacitors used in technology. • The capacitance, C, of a capacitor indicates how much charge it can store per volt. The relationship between capacitance, C, charge on either surface, Q, and voltage, V, is: $C = \frac{Q}{V}$. SI units: F • Use the above equation to calculate the capacitance, charge and the voltage between the plates. 1 F = 1 CV^{-1} • The capacitance can also be expressed as: $C = \frac{\varepsilon o\ A}{d}$ (ε_o = 8,85 x $10^{-12}Fm^{-1}$)	
	Factors affecting capacitance	• Use the above equation to calculate the capacitance, area and the distance between the plates. • Discuss the factors affecting capacitance.	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
6 hrs	**Electric circuits**		
	Power	• Define power as the rate at which electrical energy is converted in an electric circuit. $P=\frac{W}{t}$ or $P=VI$ or $P=I^2R$ or $P=\frac{V^2}{R}$ SI unit of power is W. • Practical unit of power is kWh. • Use the power equations to calculate power, voltage, current and resistance.	
	Experiment 8	• *Determine the power dissipated in bulbs connected either in series or parallel, or both series and parallel.* (Materials: Bulbs, batteries, conducting wires, crocodile clips, bulb holders, battery holders, ammeters, voltmeters etc.)	
	Heating effect of electric current	• The heat produced in a resistor in a circuit is given by: $W = I^2Rt$ SI unit is J • Use the above equation to calculate heat produced, current and resistance, and time	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
6 hrs	**Electromagnetism**		
	Magnetic effect of current-carrying conductor	• A current carrying conductor produces a magnetic field around it. • Determine the direction of the magnetic field around the current carrying conductor. • Draw the magnetic field lines around: i) a straight current carrying wire. ii) a current carrying loop (single) of wire.	Demonstrate the direction of the magnetic field around the current carrying conductor. (Using several compasses or fillings)
	Electromagnetic Induction	• Define the electromagnetic induction as the process of generating electricity from motion.	
	Magnetic flux	Define magnetic flux as the number of field lines perpendicular to the given surface. • $\Phi = BA$ SI unit is Wb	
	Magnetic flux density	• Define magnetic flux density as the number of field lines perpendicular through unit area. $B = \frac{\Phi}{A}$ SI unit: T $1T = 1\ Wb.m^{-2}$ • Use the above equation to determine the magnetic flux, magnetic flux density and area.	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
	Faraday's law	• Faraday's Law states that when the magnetic flux linked with the coil changes, an emf is induced in the coil. The magnitude of the induced emf is directly proportional to the rate of change of magnetic flux. $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$ (-ve sign indicates that the emf is in the opposite direction to the effect that produces it)	
	Lenz's law	• Lenz's law states that the direction of the induced emf in the coil opposes the effect that produces it. • Use examples from technology to demonstrate Lenz's law.	
	Experiment 10	• *Determine the effect of the change in magnetic field or magnetic flux in a coil.* • (Materials: Coil, galvanometer or ammeter, connecting wires, bar magnet, etc).	
	Transformer	• Define the transformer as a device used to step up or step down the voltage. • The output voltage is determined by the number of turns in the primary and secondary coils and the input voltage: $\frac{V_s}{V_p} = \frac{N_s}{N_p}$ • Use the above equation to determine the input voltage, output voltage, and number of turns in the primary and secondary coils.	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
		• A transformer that increases the voltage is called a step-up transformer. • A transformer that decreases the voltage is called a step-down transformer.	
	Generator	• Define a generator as a device that converts mechanical energy into electrical energy. • Explain the basic principle of an AC generator (alternator). • Explain how a DC generator works and how it differs from an AC generator.	Construct an electric motor,
	Motor	• Define a motor as a device that converts electrical energy to mechanical energy. • Explain the basic principles of an electric motor.	

Time	Topics Grade 12	Content, Concepts & Skills	Guidelines for Teachers
		Chemical Change	
10 hs	**Electrochemical cells**		
	Electrolytic cells	• Define the electrolytic cell as an electrochemical cell that converts electrical energy to chemical energy. (Non-spontaneous cell).	
	Experiment 11	• *Electrolysis of copper chloride* (Materials: Copper chloride, beaker, water, cells, connecting wires, etc).	
	Galvanic cells	• Define the galvanic (voltaic) cell as an electrochemical cell that converts chemical energy to electrical energy. (Spontaneous cell).	
	Components of galvanic cells	• State the functions of all components of the galvanic cell.	
	Experiment 12 (formal)	• Determine the electrode potential of a Cu-Zn cell. (Materials: Two beakers, zinc electrode, copper electrode, copper sulphate, zinc sulphate, potassium nitrate, connecting wires, salt bridge, voltmeter, etc).	
	Half reactions	• Give the half-reactions at the anode and cathode.	
	Net reaction	• Give the net reaction.	
	Standard conditions	• Give the standard conditions under which standard electrode potentials are determined.	
	Ionic movement	• Describe the movement of ions through the solutions and the salt bridge.	
	Standard cell notation	• Use standard cell notation or diagrams to represent a galvanic cell.	
	Emf of a cell	• Calculate the emf of the cell using the standard electrode potential table: $Emf=E_{cathode}- E_{anode}$	
	Alternate Energies Biodiesel fuel cells (photovoltaic cells)	Discuss the use of alternate energies and their environmental impact.	

SECTION 4

4. ASSESSMENT

4.1 Introduction

Assessment is a continuous planned process of identifying, gathering and interpreting information about the performance of learners, using various forms of assessment. It involves four steps: generating and collecting evidence of achievement; evaluating this evidence; recording the findings; and using this information to understand and thereby assist the learners' development in order to improve the process of learning and teaching.

Assessment should be both informal (Assessment for Learning) and formal (Assessment of Learning). In both cases regular feedback should be provided to learners to enhance the learning experience. Assessment is a process that measures individual learner's attainment of knowledge (content, concepts and skills) in a subject by collecting, analysing and interpreting the data and information obtained from this process to:

- enable the teacher to make reliable judgements about a learner's progress
- inform learners about their strengths, weaknesses and progress
- assist teachers, parents and other stakeholders in making decisions about the learning process and the progress of the learners.

Assessment should be mapped against the content, concepts and skills, and the aims specified for Technical Sciences, and in both informal and formal assessments it is important to ensure that in the course of a school year:

- all of the subject content is covered
- the full range of skills is included
- a variety of different forms of assessment are used.

4.2 Informal or daily assessment

Assessment for learning has the purpose of continuously collecting information on a learner's achievements that can be used to improve their learning.

Informal assessment is a daily monitoring of learners' progress. This is done through observations, discussions, practical demonstrations, learner-teacher conferences, informal classroom interactions, etc. Informal assessment may be as simple as stopping during the lesson to observe learners or to discuss with learners how learning is progressing. Informal assessment should be used to provide feedback to the learners and to inform planning for teaching, but need not be recorded. It should not be seen as separate from learning activities taking place in the classroom. Learners or teachers can mark these assessment tasks.

Self-assessment and peer assessment actively involves learners in assessment. This is important as it allows learners to learn from and reflect on their own performance. The results of the informal daily assessment tasks are not formally recorded unless the teacher wishes to do so. The results of daily assessment tasks are not taken into account for promotion and certification purposes.

Informal, on-going assessments should be used to structure the acquisition of knowledge and skills and should be precursors to formal tasks in the Programme of Assessment.

4.3 Formal assessment

PROGRAMME OF ASSESSMENT		
School-based Assessment – SBA	**Practical Assessment Task – PAT**	**Final Examination**
25 %	**25 %**	**50 %**

All assessment tasks that make up a formal programme of assessment for the year are regarded as Formal Assessment. Formal assessment tasks are marked and formally recorded by the teacher for progression and certification purposes. All Formal Assessment tasks are subject to moderation for the purpose of quality assurance and to ensure that appropriate standards are maintained.

Formal assessment provides teachers with a systematic way of evaluating how well learners are progressing in a grade and in a particular subject. Examples of formal assessments include tests, examinations, practical tasks, projects, oral presentations, demonstrations, performances, etc. Formal assessment tasks form part of a year-long formal Programme of Assessment in each grade and subject.

4.3.1 Control tests & examinations

Control tests and examinations are written under controlled conditions within a specified period of time. Questions in tests and examinations should assess performance at different cognitive levels with an emphasis on process skills, critical thinking, scientific reasoning and strategies to investigate and solve problems in a variety of scientific, technological, environmental and everyday contexts.

4.3.2 Practical investigations & experiments

Practical investigations and experiments should focus on the practical aspects and the process skills required for scientific inquiry and problem solving. Assessment activities should be designed so that learners are assessed on their use of scientific inquiry skills, like planning, observing and gathering information, comprehending, synthesising, generalising, hypothesising and communicating results and conclusions. Practical investigations should assess performance at different cognitive levels and focus on process skills, critical thinking, scientific reasoning and strategies to investigate and solve problems in a variety of scientific, technological, environmental and everyday contexts.

The difference between a practical investigation and an experiment is that an experiment is conducted to verify or test a known theory, whereas an investigation is an experiment that is conducted to test a hypothesis, i.e. the result or outcome is not known beforehand.

4.3.3 Projects

A project is an integrated assessment task that focuses on process skills, critical thinking and scientific reasoning, as well as strategies to investigate and solve problems in a variety of scientific, technological, environmental and everyday contexts. This requires a learner to follow the scientific method to produce either a device or a model, or to conduct a practical investigation.

A project will entail only one of the following:

(i) Construction of a device e.g. electric motor.

(ii) Building a physical model in order to solve a challenge you have identified using concepts in the FET Technical Sciences curriculum.

(iii) Practical investigation.

Note:

The learner has the **option** to include a **poster** as part of the presentation of his/her project. The assessment tools used, specifying the assessment criteria for each task, will be dictated by the nature of the task and the focus of assessment. Assessment tools could be one or a combination of rubrics, checklists, observation schedules and memoranda.

REQUIREMENTS FOR GRADE 10, 11 AND 12 PRACTICAL WORK

In Grades 10 and 11 learners will do FOUR prescribed experiments for formal assessment and ONE project. This gives a total of **FIVE formal assessments in practical work** in Physical Sciences in each of Grades 10 and 11.

In Grades 10 and 11 it is recommended that learners do TEN experiments for informal assessment. This gives a total of **FIFTEEN assessments in practical work** in Technical Sciences in each of Grades 10 and 11.

In Grade 12 learners will do THREE prescribed experiments for formal assessment and one project. This gives a total of **FOUR assessments in practical work** in Technical Sciences in Grade 12.

In Grade 12 it is recommended that learners do FIVE experiments for informal assessment. This gives a total of **FIVE informal assessments in practical work** in Technical Sciences in Grade 12.

Grades 10 and 11

Table 2: Practical work for Grades 10 and 11

Practical work	Number of tasks
Prescribed experiments (formal assessment)	4
Project (formal assessment)	1
Experiments (informal assessment)	10
TOTAL	**15 practical activities**

Grade 12

Table 3: Practical work for Grade 12

Practical work	Number of tasks
Prescribed experiments (formal assessment)	3
Project (formal assessment)	1
Experiments (informal assessment)	5
TOTAL	**9 practical activities**

4.4 Programme of Assessment

The Programme of Assessment is designed to spread formal assessment tasks in all subjects in a school throughout a term.

4.4.1 Programme of formal assessment for Grades 10, 11 and 12

Assessment consists of three components: SBA (25 %), PAT (25%) and the final examination which makes up the remaining 50%. The following table illustrates the assessment plan and weighting of tasks in the programme of assessment for Technical Sciences Grades 10, 11 and 12.

PROGRAMME OF ASSESSMENT FOR GRADES 10, 11 and 12						
ASSESSMENT TASKS (25%) + PAT (25%)						END-OF-YEAR ASSESS-MENT (50%)
TERM 1		TERM 2		TERM 3		TERM 4
Type	Mark	Type	Mark	Type	Mark	**Final Examination (2 x 150 marks giving a total of 300 marks for papers 1 and 2)**
Experiment (SBA)	20	**Experiment (SBA)**	30	**Experiments (PAT)**	100	
Control Test (SBA)	20	**Mid-Year Examination (SBA)** **Project (PAT)**	40 50	**Trial Examination (Grade 12)** **Control Test (Grades 10 and 11) (SBA)**	40	
Total: 40 marks		Total: 120 marks		Total: 140 marks		Total: 300 marks
Total = 600 marks						
FINAL MARK = 25% (ASSESSMENT TASKS), 25 % (PAT) + 50% (FINAL EXAM) = 100%						

* PAT will consist of two experiments (one in Physics and one in Chemistry) + One Project. These will be set annually by the DBE.

4.4.2 End-of-year Examinations

4.4.2.1 Grades 10 and 11 (internal assessment)

The end-of-year examination papers for Grades 10 and 11 will be internally set, marked and moderated, unless otherwise instructed by provincial departments of education.

The internally set, marked and moderated examination will consist of two papers.

4.4.2.2 Grade 12 (external assessment)

The external examinations are set externally, administered at schools under conditions specified in the *National policy on the conduct, administration and management of the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF)* and marked externally.

The core content outlined in the Technical Sciences Curriculum and Assessment Policy (CAPS) document is compulsory and will be examined through Papers 1 and 2. Note that all the topics in the Grade 12 curriculum are examinable in the end of year examination.

Multiple-choice questions could be set in examination papers. However, such questions should have a maximum weighting of 10%. The examination paper may also consist of conceptual type questions.

The final end-of-year examination is nationally set, marked and moderated.

The nationally set, marked and moderated examination will consist of two papers:

- Paper 1: (3 hours, 150 marks)
- Paper 2: (3 hours, 150 marks)
- All of the questions will focus on content as stated in the National Curriculum Statement.

4.4.2.3 Year-end Examination Content for Paper 1 and Paper 2: Technical Science

Grade	Paper 1	Paper 2
10	Mechanics and Electrostatics	Matter and materials, Chemical change, Heat and thermodynamics
11	Mechanics, Magnetism and Electricity	Chemical change, Heat and thermodynamics, Waves and Sound
12	Mechanics, Magnetism and Electricity	Organic chemistry, Chemical change, Waves, Sound and Light

4.4.2.4 Weighting of topics in papers 1 and 2

Grade 10				
Paper	**Content**	**Percentage**	**Total marks per paper**	**Duration (hours)**
Paper 1	Mechanics	68	150	3
	Electricity and Magnetism	32		
Paper 2	Matter and materials	84	150	3
	Chemical change	0		
	Heat and thermodynamics	16		
	Waves, Sound and Light	0		

Grade 11				
Paper	**Content**	**Percentage**	**Total marks per paper**	**Duration (hours)**
Paper 1	Mechanics	47	150	3
	Electricity and Magnetism	53		
Paper 2	Chemical change	23	150	3
	Heat and thermodynamics	21		
	Waves, Sound and Light	56		

Grade 12				
Paper	**Content**	**Marks**	**Total marks per paper**	**Duration (hours)**
Paper 1	Mechanics	72	150	3
	Electricity and magnetism	28		
Paper 2	Organic chemistry	36	150	3
	Chemical change	28		
	Waves, Sound and Light	36		

4.5 Recording and reporting

Recording is a process in which the teacher documents the level of a learner's performance in a specific assessment task. It indicates learner progress towards the achievement of the knowledge and skills as prescribed in the Curriculum and Assessment Policy Statements. Records of learner performance should provide evidence of the learner's conceptual progression within a grade and her/his readiness to progress or be promoted to the next grade.

Records of learner performance should also be used to verify the progress made by teachers and learners in the teaching and learning process.

Reporting is a process of communicating learner performance to learners, parents, schools and other stakeholders.

Learner performance can be reported in a number of ways. These include report cards, parents' meetings, school visitation days, parent-teacher conferences, phone calls, letters, class or school newsletters, etc. Teachers in all grades report in percentages against the subject.

4.5.1 Recording and reporting in the first, second and third terms

Schools are required to provide quarterly feedback to parents on the Programme of Assessment using a formal reporting tool such as a report card. The schedule and the report card should indicate the overall level of performance of a learner. Schools should use the following weighting for **reporting purposes only** and only in the **first, second and third** terms of Grades 10, 11 and 12:

	Practical Work	**Control test/mid-year exam**
Weighting	50 %	50 %

4.5.2 Recording and reporting on the Assessment Tasks and SBA in the Programme of Assessment

Schools are also required to provide quarterly feedback to parents and learners of the marks obtained by learners in the assessment tasks as given.

4.5.3 Recording and reporting at the end of the academic year

The weighting of tasks in the Programme of Assessment must be strictly adhered to when calculating the final mark of the learner for promotion purposes in each of Grades 10, 11 and 12, at the end of the academic year.

4.6 Moderation of Assessment

4.6.1 SBA

Moderation refers to the process that ensures that the assessment tasks are fair, valid and reliable. Moderation should be implemented at school, district, provincial and national levels. Comprehensive and appropriate moderation practices must be in place for the quality assurance of all subject assessments.

All Grade 10 and 11 tasks are internally moderated. The subject head or head of department for Technical Sciences at the school will generally manage this process.

All Grade 12 tasks should be externally moderated. The subject head or head of department for Technical Sciences at the school will generally manage this process.

4.6.2 PAT

The final phase of the PAT (both project and experiments) will be assessed by the teacher and externally moderated by the Provincial subject specialist, for Grade 12 only. Each Province will set out dates for external moderation. Learners will be selected randomly to demonstrate skills from PAT (both project and experiments).

4.7 General

This document should be read in conjunction with:

4.7.1 [National Protocol of Assessment] *An addendum to the policy document, the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF), regarding the National Protocol for Assessment (Grades R – 12).*

4.7.2 Progression and Promotion Requirements Grades 1 – 12.

4.7.3 Subject specific exam guidelines as contained in the draft policy document:

National policy pertaining to the programme and promotion requirements of the National Curriculum Statement, Grades R – 12.