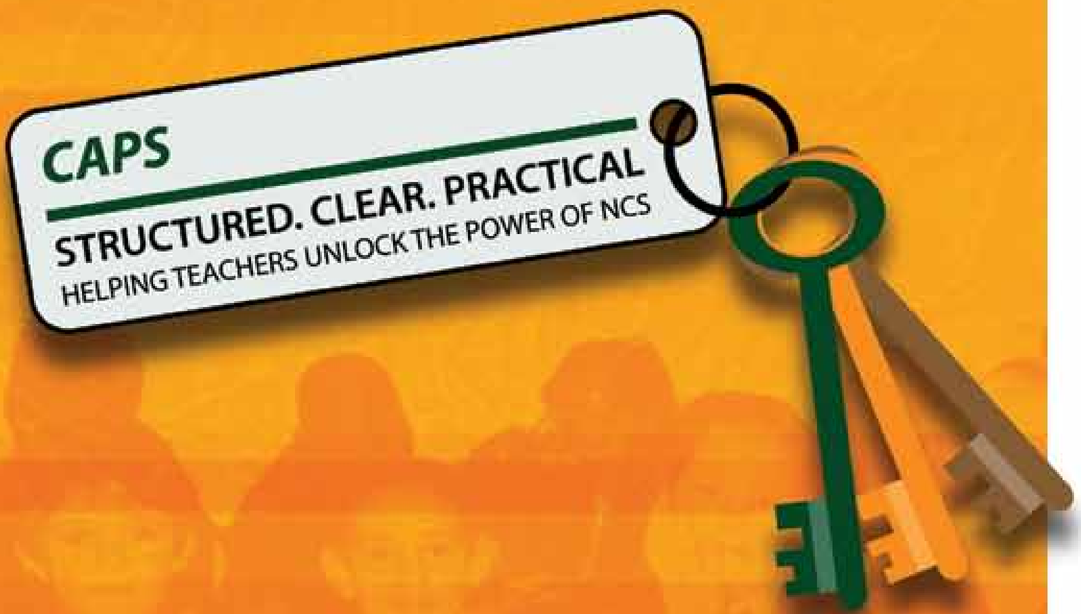
TECHNOLOGY

National Curriculum Statement (NCS)

Curriculum and Assessment Policy Statement



Senior Phase
Grades 7-9

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

basic education

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CURRICULUM AND ASSESSMENT POLICY STATEMENT
GRADES 7-9

TECHNOLOGY

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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) and the *National Curriculum Statement Grades 10-12* to produce this document.

From 2012 the two National Curriculum Statements, 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* represents a policy statement for learning and teaching in South African schools and comprises of the following:

(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

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SECTION 1: INTRODUCTION TO THE CURRICULUM AND ASSESSMENT POLICY STATEMENT

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;

- 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 in the Foundation Phase is as follows:

SUBJECT	GRADE R (HOURS)	GRADES 1-2 (HOURS)	GRADE 3 (HOURS)
Home Language	10	8/7	8/7
First Additional Language		2/3	3/4
Mathematics	7	7	7
Life Skills • Beginning Knowledge • Creative Arts • Physical Education • Personal and Social Well-being	**6** (1) (2) (2) (1)	**6** (1) (2) (2) (1)	**7** (2) (2) (2) (1)
TOTAL	**23**	**23**	**25**

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

(c) Ten hours are allocated for languages in Grades R-2 and 11 hours in Grade 3. A maximum of 8 hours and a minimum of 7 hours are allocated for Home Language and a minimum of 2 hours and a maximum of 3 hours for Additional Language in Grades 1-2. In Grade 3 a maximum of 8 hours and a minimum of 7 hours are allocated for Home Language and a minimum of 3 hours and a maximum of 4 hours for First Additional Language.

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

1.4.2 Intermediate Phase

(a) The instructional time in the Intermediate Phase is as follows:

SUBJECT	HOURS
Home Language	6
First Additional Language	5
Mathematics	6
Natural Sciences and Technology	3, 5
Social Sciences	**3**
Life Skills • Creative Arts • Physical Education • Personal and Social Well-being	4 (1, 5) (1) (1, 5)
TOTAL	**27, 5**

1.4.3 Senior Phase

(a) The instructional time in the Senior Phase is as follows:

SUBJECT	HOURS
Home Language	5
First Additional Language	4
Mathematics	4, 5
Natural Sciences	3
Social Sciences	**3**
Technology	2
Economic Management Sciences	2
Life Orientation	2
Creative Arts	2
TOTAL	**27, 5**

1.4.4 Grades 10-12

(a) The instructional time in Grades 10-12 is as follows:

SUBJECT	TIME ALLOCATION PER WEEK (HOURS)
Home Language	**4.5**
First Additional Language	**4.5**
Mathematics	**4.5**
Life Orientation	**2**
A minimum of any three subjects selected from **Group B** Annexure B, Tables B1-B8 of the policy document, *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R-12,* subject to the provisos stipulated in paragraph 28 of the said policy document.	**12 (3x4h)**
TOTAL	**27, 5**

The allocated time per week may be utilised only for the minimum 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 offer additional subjects, additional time must be allocated for the offering of these subjects.

SECTION 2

INTRODUCTION TO TECHNOLOGY

2.1 PURPOSE

Technology education was introduced into the South African curriculum in recognition of the need to produce engineers, technicians and artisans needed in modern society and the need to develop a technologically literate population for the modern world. The subject stimulates learners to be innovative and develops their creative and critical thinking skills. It teaches them to manage time and material resources effectively, provides opportunities for collaborative learning and nurtures teamwork. These skills provide a solid foundation for several FET subjects as well as for the world of work.

In the educational context, Technology can be defined as:

The use of knowledge, skills, values and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration.

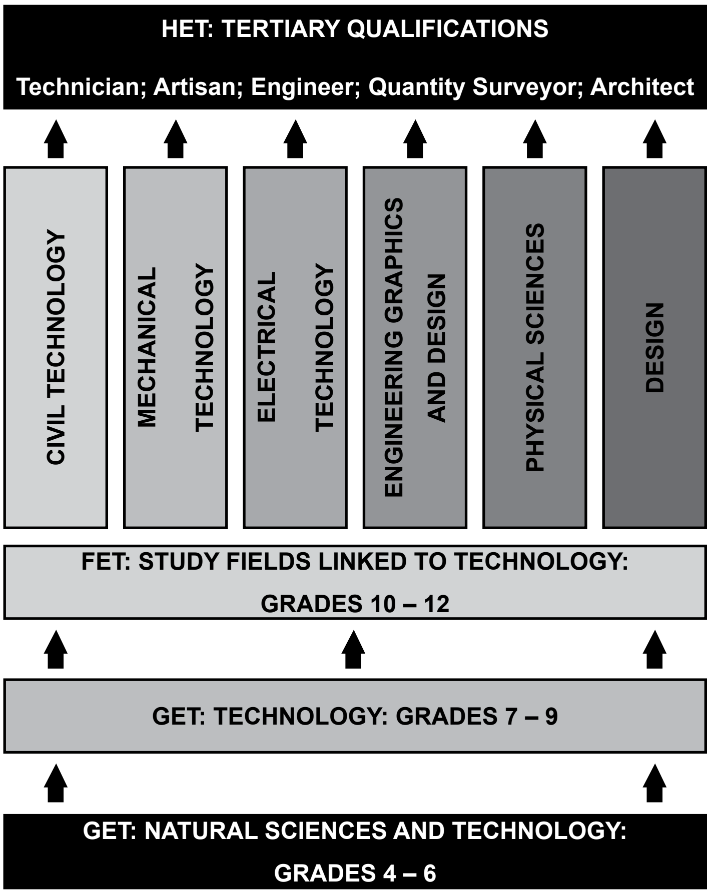
2.2 SPECIFIC AIMS

Technology as a subject contributes towards learners' <u>technological literacy</u> by giving them opportunities to:

- Develop and apply specific design skills to solve technological problems.
- Understand the concepts and knowledge used in Technology education and use them responsibly and purposefully.
- Appreciate the interaction between people's values and attitudes, technology, society and the environment.

The intention is to **introduce** learners to the **basics** needed in Civil Technology, Mechanical Technology, Electrical Technology and Engineering Graphics and Design. Additionally, learners gain an idea of the way engineers apply scientific principles to practical problems. In addition, **evaluation** skills will be fostered and the introduction of product **design** and **production** will be useful in other FET subjects that use these skills – such as Consumer Studies and Design.

It is expected that Technology education will provide learners with some experience to **help** them to make career-oriented **subject choices at the end of Grade 9**.



2.3 UNIQUE FEATURES AND SCOPE

Technology will teach learners the opportunity to learn:

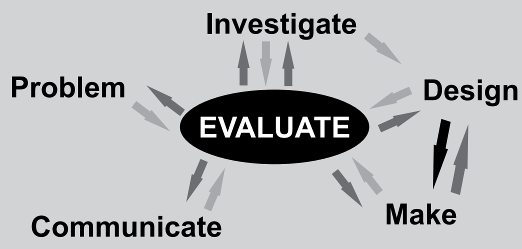
> **Key issues to teach:**
> **1. Problem solving using the design process**
> **2. Practical skills**
> **3. Knowledge and application of knowledge.**

- To solve problems in creative ways;
- To use authentic contexts rooted in real situations outside the classroom;
- To combine thinking and doing in a way that links abstract concepts to concrete understanding;
- To evaluate existing products and processes; and to evaluate their own products;
- To use and engage with knowledge in a purposeful way;
- To deal with inclusivity, human rights, social and environmental issues in their tasks;
- To use a variety of life skills in authentic contexts (such as decision making, critical and creative thinking, cooperation, problem solving and needs identification);
- While creating positive attitudes, perceptions and aspirations towards technology-based careers.
- To work collaboratively with others:

- Through practical projects using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles.

2.4 TOPICS AND CORE CONTENT AREAS IN TECHNOLOGY

- The table below indicates the main focus areas in the Technology curriculum:

<table>
<tr><td>1.</td><td>THE DESIGN PROCESS SKILLS (non-linear):
• Investigation skills
• Design skills
• Making skills
• Evaluation skills
• Communication skills


</td></tr>
<tr><td>2.</td><td>STRUCTURES</td></tr>
<tr><td>3.</td><td>PROCESSING OF MATERIALS</td></tr>
<tr><td>4.</td><td>MECHANICAL SYSTEMS AND CONTROL</td></tr>
<tr><td>5.</td><td>ELECTRICAL SYSTEMS AND CONTROL</td></tr>
<tr><td>6.</td><td>TECHNOLOGY, SOCIETY AND THE ENVIRONMENT
• Indigenous technology
• Impact of technology
• Bias in technology</td></tr>
</table>

There are four core content areas in Technology in grades 7 – 9. These are:

STRUCTURES	PROCESSING	MECHANICAL SYSTEMS AND CONTROL	ELECTRICAL SYSTEMS AND CONTROL

NB: All electric circuits must be battery powered in the GET Band – Max 9V dc.

These four content areas form the basis of the **four strands** which must be done each year in every grade. Where possible in the senior phase, the learner should engage in projects that **integrate** processing, structures and systems and control. The recommended approach will be to introduce the required knowledge followed by **practical** work in which the knowledge is applied. In all cases, the teaching will be structured using the ***Design Process*** as the backbone for the methodology. Some of these elements will be assessed formally each term.

As learning progresses, learners must be made aware of the interrelationship between technology, society and the environment. Wherever applicable, learners should be made aware of different coexisting knowledge systems. They should learn how **indigenous cultures** have used specific materials and processes to satisfy needs, and become aware of indigenous intellectual property rights. Learners should be able to consider the **impact of technology,** both positive and negative, on people's lives. Learners should be made aware of **bias in technology** and be able to express opinions that explain how certain groups within society might be favoured or disadvantaged by products of technology.

2.5 THE IMPORTANCE OF DESIGN IN TECHNOLOGY EDUCATION

No product has ever been manufactured that did not undergo development through ***design***. Technology education is an introduction to a range of careers that work in similar ways. All tend to use the **design process** as they develop solutions to problems, needs or wants. The country needs informed, critical consumers and producers of knowledge.

A key element to teach is the ability to ***design***.

With many similar products on the market, design excellence is a key element in attracting consumers.

"*Whether it is style on the outside or innovative technology on the inside, cutting-edge design is now more than ever vital in keeping a company or product competitive. Is it ergonomically sound? Will it stand up to repeated use or resist abuse? Is it designed to be 'fit-for-purpose'? Will the consumer see value in it? Will it be safe to produce and use? Will it impact negatively on certain groups? Is it environmentally friendly?"* **Ref: *The Design Encyclopaedia.***

Examples of careers that use design:

Civil engineering – designing a bridge. Architecture – designing a house. Textile design – developing a textile for a specific purpose. Electrician – designing the electrical wiring for a lamp.	Dietician – designing a diet to combat malnutrition and obesity. Mechanical engineering – designing a machine. Structural engineering – designing a support system for the roof of a stadium.

Designers need to have...

- an **understanding** of the problem, need or opportunity;
- **knowledge** of the design process;
- **knowledge** of types and properties of suitable materials, and how to use them optimally;
- the ability to **calculate** the quantities and costs of the materials needed;
- **knowledge** of the conventions / building codes;
- an ability to **sketch** initial ideas on paper;
- the ability to **draw** working drawings in sufficient detail for the task;
- the practical skills required to **create a** solution;
- the ability to work **safely** using appropriate tools;
- the ability to adhere to health precautions;
- the ability to **present** the solution effectively to the client / customer.

Learners need to work collaboratively with others; doing practical projects using a variety of technological skills (investigating, designing, making, evaluating and communicating) to suit different learning styles.

2.6 TEACHING METHODOLOGY (*HOW TASKS WILL BE APPROACHED*)

NB: As learners progress through a task, they must be **taught** the associated knowledge and the skills needed to **design and create** a solution.

Knowledge is important BUT the learners must show that they can **use the knowledge**, and not just memorise it.

The **Design Process** (**I**nvestigate, **D**esign, **M**ake, **E**valuate, **C**ommunicate – **IDMEC**) forms the *backbone* of the subject and should be used to structure the delivery of all learning aims. Learners should be exposed to a problem, need or opportunity as a starting point. They should then engage in a systematic process that allows them to develop solutions that solve problems, rectify design issues and satisfy needs.

Investigation in this subject involves finding out about *contexts and needs*, investigating or evaluating *existing products* in relation to key design aspects and *performing practical tests* to develop understanding of particular aspects of the content areas or determining a product's fitness-for-purpose. While investigating, learners should be provided with opportunities to explore values and attitudes and develop informed opinions that can help them to make compromises and value judgements. Investigation can happen at any point in the Design Process. It should not be seen as something that must be completed before design begins.

Designing, making and evaluating. These skills should not be seen as separate – they are inter-related.

Evaluation skills, for example, are used to choose ideas. At this level, learners should be introduced to key aspects of design. These should be used to evaluate both existing and designed products against predetermined criteria. When **making**, learners should be encouraged to continue to reflect on their progress against these criteria and to modify their solutions based on problems encountered. As learners progress they should be able to demonstrate ***increasing accuracy and skill***, ***better organisation*** and ***safer working practices***.

Criteria for teaching and assessing design features:

- Originality and aesthetics
- Value for money/cost effectiveness
- Fit-for-purpose and suitability of materials
- Ease of manufacture
- Safety and ergonomics
- Environmental impact
- Bias towards or against a group

Communication should also be seen as integral to the overall process. Learners should be recording and presenting progress in written and graphical forms on an on-going basis. Their presentations should show increasing use of media, levels of formality and conventions as they progress through the phase.

Technology develops valuable problem-solving skills that will benefit every learner in many life contexts.

The Grade 9 learner must be able to *identify and explain a problem, need or opportunity* from a *given real-life context.*

Note on drawing:

In Grades 7 – 9 Technology, drawing is separated into three fields:

- **Free-hand sketches** in the **design stage.**
- **Working drawings** in the **making stage**, using formal draughting techniques in line with conventions.

- **Artistic impressions** in the **communication stage**, using artistic techniques including perspective, texture rendering, shading, colours and shadows in order to **advertise** the product to potential users.

NB: Perspective drawing here is purely **artistic** and has **no link** to the method of linking the perspective to the working drawing, using formal construction lines. In Technology, learners draw both technical AND artistic graphics.

2.7 TIME ALLOCATION FOR TECHNOLOGY

The teaching time for Technology is two (2) hours per week. As this subject involves practical work, 60 minutes of the two hours should be one continuous period for practical work, e.g. one double period comprising two periods of 30 minutes.

Schools using alternative period lengths, or a cycle system, must ensure that all subjects get their correct time allocation and that sufficient time is allocated for practical sessions.

2.8 REQUIREMENTS FOR TECHNOLOGY

1. Each learner must have:
    - An approved textbook.
    - A 72-page A4 workbook/exercise book. (In secondary schools learners may require two books per year.)
    - Stationery including basic mathematical set (drawing instruments): pencil, eraser, ruler and set squares.
2. A designated teaching venue with a Technology teacher.
3. Technology rooms must be secure, with doors that lock, and with burglar-proofing if possible. Enough cupboards should be available to store and lock away all resources.
4. It is **the responsibility of the school** to provide each learner with the minimum tools and material to meet the needs of the subject (see Annexure B for possible tools and resources) and to develop the teacher's appropriate knowledge and skills.
5. **Enabling tasks:** Activities used to teach and then practise specific skills in preparation for a more advanced task – sometimes also called resource tasks. These tasks are assessed informally.
6. **Mini-PAT:** A short Practical Assessment Task which makes up the main formal assessment of a learner's skills and knowledge application during each term. It may be an assignment covering aspects of the design process, or it may be a full capability task covering all aspects of the design process (IDMEC).

NOTE: The **curriculum for Grade 7** has been **described very specifically** to ensure that all these learners cover the same work in all schools across the country before graduating to secondary schools. Some limited variations will be developed by the various textbook authors. The **curriculum for Grade 8** has some sections described fairly specifically while other sections give a lot of freedom for the innovation expected from textbook authors. The Grade 9 learners have to be able to "identify a problem, need or opportunity" in a given context. Consequently the **curriculum for Grade 9** is non-specific and textbook authors have free reign to develop ideas that suit the **given content**.

SECTION 3: CURRICULUM STATEMENT

3.1 FOCUS CONTENT, CONCEPT AND SKILLS FOR GRADE 7 TERM 1-4

<table>
<tr><th colspan="3">GRADE 7 TERM 1</th></tr>
<tr><td colspan="3">It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to. Skills – investigating, drawing, designing, making and presenting – should improve progressively from term to term.</td></tr>
<tr><td>Hrs</td><td>Focus</td><td>Content, concepts and skills Enabling Tasks</td></tr>
<tr><td colspan="3">Enabling tasks – build the capability to complete the formal assessment tasks later in the term</td></tr>
<tr><td>2</td><td>Design process skills</td><td>• Introduction: What is Technology?
• Definition
Scope – who does Technology in the ‘world of work’?
• How we will be working – the development of a technology task:
- Investigate: find, use and acknowledge information.
- Design: design brief, specifications, constraints; initial idea sketches; choosing the best design; selecting materials.
- Make: draw plans; develop the manufacturing sequence; make the item/model.
- Evaluate: learners evaluate both their design stages and their final product.
- Communicate: learners present their solutions; learners compile all notes and drawings into a project report in their workbooks.
Design considerations
• Fitness-for-purpose: Who is it for? What is it for? Will it do the job? Is it cost effective? Is it safe? Is it easy to use (ergonomics)? Does it look good (aesthetics)? Will it affect society? Will it affect the environment?</td></tr>
<tr><td>2</td><td rowspan="2">Communication skills</td><td>Introduction to graphical communication
• Purpose of graphics: develop ideas and communicate ideas.
• Conventions: outlines (thin/dark); construction lines (thin/feint); hidden detail (dashed) scale; dimensioning.
• Sketch: free-hand sketching.
• Working Drawings: two-dimensional drawing of ONE face of an object using conventions (dark lines; feint lines; dashed lines; dimensions; scale).</td></tr>
<tr><td>2</td><td>Graphic techniques
• 3D oblique – front view with depth at 45^o (use squared ‘quadrant’ paper); oblique projection used to assist with interpretation, and with drawing single VP perspective.
• 3D artistic - single vanishing point perspective with colour, texture and shading.</td></tr>
<tr><td>2</td><td rowspan="2">Mechanical systems and control</td><td>Simple mechanisms
Levers – mechanical advantage: simple quantitative treatment – no calculations using moments. Examine the relationship between load, effort and their distances from the pivot.
• First-class levers: characteristics (fulcrum/pivot placed between effort and load).
• First-class levers may give a mechanical advantage or not – depending on pivot position.
• Case study: first-class levers with mechanical advantage: MA > 1 ; MA = 1 ; MA < 1 .</td></tr>
<tr><td>2</td><td>• Second-class levers: characteristics (load is placed between effort and fulcrum); give real examples.
• Learners demonstrate models of second-class levers, which always give a mechanical advantage.
• Third-class levers: characteristics (effort is placed between load and fulcrum): give real examples
• Learners demonstrate models of third-class levers, which never give a mechanical advantage.</td></tr>
</table>

2	**Investigation skills**	**Practical investigation**: Levers and linkages • Examine simple linked first-class levers (e.g. pair of scissors; pair of pliers; hedge trimming shears). • Examine simple linked second-class levers (e.g. office punch, nut crackers). • Examine simple linked third-class levers (e.g. most office staplers, pair of tweezers). • Examine more complex linkages (e.g. linkages with more than one pivot)

FORMAL ASSESSMENT TASK: Mini-PAT	**TOPIC: Mechanical Systems and Control**	
CONTEXT: JAWS-OF-LIFE: Rescue System	**CONTENT: Levers, linkages, hydraulics, pneumatics**	**[70%]**
2	**Impact of technology** **Mechanical systems and control**	• **Scenario:** Impact of technology – emergency workers use "Jaws-of-Life" system to rescue trapped accident victims. **Pneumatics and Hydraulics** • Using pneumatics and hydraulics to obtain a mechanical advantage.. • Practical Investigations: - Force transfer between two equal syringes filled with 1) air and 2) water. - Force transfer between two unequal syringes filled with 1) air and 2) water.
2	**Design skills**	Learners develop a working model of a hydraulic-syringe powered, linked-lever rescue device using simple materials. • Write a design brief, specifications and constraints: • Draw a 3D drawing of the idea in oblique projection using dark and feint lines . • Draw working drawing in 2D showing one view with dimensions to scale.
3	**Making skills**	Learners make a simple working model. *(At a minimum, the "Jaws-of-Life" model may be a simple device representing how any one machine in the "Jaws-of-Life" system will work using plastic tubing, syringe(s) and cardboard.)*
1	**Formal Assessment Task: Test (Note:** the test may be written before the Mini-PAT**)**	**[30%]**

Formal Assessment: Term 1:	**Weighting: 10% of promotion mark**		
	Mini-PAT: [70%]	**Test: [30%]**	**Total: 100%**

GRADE 7 TERM 2

It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to.

Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.

Hrs	Focus	Content, concepts and skills Enabling Tasks
2	**Structures**	• Definition and purpose of structures to contain, protect, support, span. • Classification of structures: natural and man-made. **Types of structures: shell, frame, solid – learners complete a worksheet.**
1		• Investigate: a cell phone tower – a frame structure • Case study: examine existing towers strengthened by triangulation, including pylons, windmills and mine headgear. • Evaluate: worksheet on the advantages and disadvantages of telephone systems; **Landline vs. mobile. Learners complete a table.**
1		**Action research: to stiffen materials / structures** • Practical activity 1 – Stiffen a structural material by tubing. • Practical activity 2 – Stiffen a structural material by folding. **Practical activity 3 – Stiffen a frame structure by** triangulation.
2	**Structures** **Impact of technology** **Design skills** **Investigation skills**	**Investigating design issues:** • **Case study:** study photographs of existing cell phone towers noting structural elements, reinforcing techniques and design issues such as visual pollution, stability, base size and centre of gravity. • **Class discussion:** how designers consider the needs of society in terms of technology while considering the impact on society and on the environment. • **Case study** – existing designs 1: examine the ***features*** of a school desk; write the ***design brief*** with ***specifications*** for a school desk. Case study **– existing designs 2: examine an existing product (FM radio/cell phone), list its features and then write a design brief with specifications for that product.**

FORMAL ASSESSMENT TASK: Mini-PAT **TOPIC: Structures**

CONTEXT: The cell phone tower CONTENT: Frame structures [70%]

Hrs	Focus	Content, concepts and skills
3	**Structures** **Design skills** **Impact of technology** **Design Evaluation skills**	**Scenario**: Cell phone towers are everywhere and are built using materials to ensure stability, strength and rigidity (stiffness). • **Write the design brief**: Individual learners write the design brief with specifications for a new cell phone tower. **Note:1.** At a minimum, the cell phone tower can consist of struts made of found materials like "Elephant grass" or rolled paper dowels. It should show reinforcing using triangular webs, gussets and internal cross-bracing. **Note 2:** One of the design ideas must involve disguising the tower so that it blends in with the environment, avoiding visual pollution. • **Sketch initial ideas**: Individual learners draw free-hand sketches to show ***two*** different design ideas in 3D for a cell phone tower to be erected near the school. - Draw one idea using oblique projection. - Draw the other idea using single vanishing point perspective. - Learners form groups to examine and discuss the various design ideas of the individuals in the group. They evaluate the sketches of each individual to determine advantages and disadvantages of each design. Individual learners now adapt their own design ideas in terms of the group evaluation, making any necessary improvements.

2	**Making skills** **Evaluation skills (design and drawing)**	Making includes working drawings, choosing materials and tools, and building the model. Measuring and simple tool skills must be developed. Safe, cooperative working is a key skill and needed in the world of work. • Each learner lists the resources to be used. • Each learner draws a working drawing for the cell phone tower showing one face in 2D. • Learners form teams and select the best plan from those drawn by each team member. They develop the design they chose by consensus from the plans drawn by each group member. The team adapts a final plan (working drawing) from these inputs - assess informally.
3	**Making skills** **Evaluation skills**	Build the model: Teams build the model according to the Design Brief, using safe working practices. Teams develop a rubric they will use to evaluate the presentations of the other teams.
	Communication skills **Evaluation skills**	Presentation ≈ 5 minutes per team: • Teams *plan* a joint strategy to present their model and plans. • Teams *present* their design sketches, modifications, plans and models to the class. Each learner explains the role s/he played, sharing the role of spokesperson. Learners can enhance their presentation using posters giving an artist's impression of their completed cell phone tower in position near the school drawn using single VP perspective. During the team presentations, *each* team uses their rubric to assess presentations of at least two teams.
1	**Formal Assessment Task:**	**Term Test** **[30%]**
Formal Assessment: Term 2: Weighting: 10% of promotion mark		**Mini-PAT: [70%] Formal Term Test: [30%] Total: 100%**

GRADE 7 TERM 3		
It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to. Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.		
In preparation for the school recycling and fund-raising activity in week 2, learners must begin to collect data on waste materials generated both at school and at home from the first day of term 3.		
Hrs	**Focus**	**Content, concepts and skills** **Enabling Tasks**
2	**Electrical systems and control** **Investigation skills**	• **Investigate:** What is magnetism? • **Practical investigation:** Different types of <u>permanent</u> magnets – bar and horseshoe. *Optional extension activity: Learners find the shapes of magnetic fields using iron filings on paper above magnets*. • **Experiment:** Group work – learners find out which substances stick to a magnet. *They tabulate their test results, trying wood, plastic, iron, paper, copper, old nickel coins, etc. They should conclude that <u>some</u> metals do stick to magnets but that non-metals don't.*
2	**Investigation skills** **Impact of and bias in technology**	• **Experiment**: Which ***metals*** are attracted by a magnet, and which are not? Learners test metal samples made of iron, steel (an iron alloy), nickel – which will stick. Learners test metal samples made of copper, lead, aluminium brass – which do not stick. Each learner completes a table of the results. **Note**: *avoid iron coated with copper (like some paper clips) which will stick to magnets*. • **Case study: Recycling scrap metals.** Honest gleaners who collect scrap metal and deliver it to scrap metal dealers perform a valuable service to society. This good work is tainted by the criminal acts of thieves who steal copper telephone wire and steel manhole covers. • **Recycling scheme for your school**: Learners tabulate a record of the waste produced by the school, e.g. empty cans, paper, plastic, etc. Learners suggest a viable strategy to raise funds by recycling
2	**Electrical systems and control** **Making skills** **Communication skills**	• **Simple electric circuits.** Demonstrate a simple electric circuit with an energy source (cell), switch, conductor and a light bulb or buzzer. Sketch the circuit showing how to use component symbols. • **Practical**: Learners work in groups to make a simple circuit as demonstrated. • **Circuit diagram**: Each learner draws the circuit using correct symbols for components. • **Demonstration lesson:** A simple electromagnet. Make a simple electromagnet made by winding insulated copper wire around an iron nail. When an electric current flows in the wire coil (solenoid) a magnetic field is created and this is amplified by the iron core. Switching the current off causes the magnetic field to fade away. (Note: electromagnetism is a key to a wide range of technologies making up our modern world.)
2	**Mechanical systems and control**	• **Introductory lesson:** All complex machinery consists of combinations of simple mechanisms. Machines can be designed to give the user a "mechanical advantage". Levers were looked at in term 1. Introduce learners to cranks and pulleys. The crank – an adaptation of a second-class lever. • The pulley – a type of wheel and axle. • **Revision**: a) What is mechanical advantage? b) Strengthening frame structures
FORMAL ASSESSMENT TASK: Mini-PAT **TOPIC: Electrical Systems and Control / Structures / Mechanisms** CONTEXT: Recycling and Impact CONTENT: Structures and Electricity / Cranks and Pulleys [70%]		
Scenario: A scrap-metal dealer sorts magnetic and non-magnetic metals into separate piles for recycling. The simplest way to do this is to use a crane with a magnet BUT it is difficult to remove the metals that do stick to permanent magnets. ***It would be beneficial to have a magnet that can switch on and off.***		

NOTE 1: The model cranes should be made using simple materials (e.g. paper dowels, ‘elephant’ grass, etc.).

It will be a simple frame structure with a pulley and crank mechanism. Sufficient strength and rigidity should be achieved by triangulation. Measuring and simple tool skills must be developed. Safe, cooperative working is a key skill and needed in the world of work.

NOTE 2: The electromagnet will be strongest if a long insulated wire is used – wire over 100m long is very effective. The wire should be wound around a “relatively soft” iron core. Avoid using a steel bolt (it is far too hard). A fairly soft core can be made using a bundle of short lengths of iron wire. Nails are softer than bolts but are still fairly hard. Increasing the current by using more cells in a series battery has a small influence in the strength of the electromagnet.

2	**Investigation skills** **Design skills**	*Learners must use their knowledge of structures and the drawing skills developed in earlier tasks, together with their new knowledge of magnetism, electric circuits and electromagnets as well as their new knowledge of cranks and pulleys to design and make a crane using an electromagnet to sort metals in a scrap-yard.* • **Case study:** Examine pictures of cranes in order to get ideas to be used in the learner’s own designs. • **Write a design brief** with specifications and constraints for a crane with electromagnet. • **Sketch** two possible designs for a suitable crane using single VP perspective. • **Draw a circuit diagram** for the electromagnet (with a light to show when it is on).
2	**Communication skills** **Making skills**	• **Revision:** Revise the 3D oblique drawing technique; line types; scale; dimensions. • **Drawing:** Each learner uses the Oblique technique to draw an idea for the crane chosen from the two ideas sketched the previous week. The idea should be drawn on squared paper (quadrant) using pencil and ruler. • **Flow chart:** Each learner works out a flow chart detailing the sequence of manufacture of the crane with its electromagnet.
3	**Making skills**	**A working model:** *At a minimum the crane should be made of simple materials like elephant grass, rolled paper dowels or bought materials. It should show the learner’s understanding of reinforcing techniques. The mechanisms must function and the crane should be able either to pivot or to raise and lower its arm. The electromagnet should have a switch, a light to show when it is ‘on’, and should be strong enough to pick up several steel paper clips, coins or nails.* • **Electromagnet**: Using an electrochemical cell, a switch, a light bulb, a ‘soft’ iron core and a ***long*** length of insulated copper wire, the teams of learners make an electromagnet. • **Crane**: Learners work safely in teams using simple materials to make a model crane with a crank and pulley system which will carry the electromagnet that will sort the ferrous metals (iron and steel) from the non-ferrous metals (copper, aluminium, lead, brass, etc.)
2	**Evaluation skills** **Communication skills**	The learner’s ability to evaluate a product or a process is developed further. • Each learner develops a rubric to evaluate the models of other teams. • Each team uses the rubric to evaluate the models of other teams. Assess each learner’s objectivity, fairness and the validity of their comments. • Teams plan a joint strategy to present their model and plans to the class. All team members must explain their ideas and roles they played when they present.
2	**Communication skills**	• Each team presents the design sketches, working drawings and functioning model to the class. They demonstrate how strong their electromagnet is and show that it releases the load when switched off. Each learner explains the role s/he played and shares the role of spokesperson. They explain the principles involved with the magnetic sorting and how their electromagnet could be made stronger. They comment on the value of recycling and explain how sorting the metals into types, improves their scrap value. They enhance their presentation using posters giving an artist’s impression of their completed crane and electromagnet in use.
1	Formal Assessment Task:	Test **(Note: the test may be written before the Mini-PAT)** [30%]

Formal Assessment: Term 3: Weighting: 10% of promotion mark

Mini-PAT: [70%] Test: [30%] Total: 100%

<table>
<tr><th colspan="3">GRADE 7 TERM 4</th></tr>
<tr><td colspan="3">It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to. Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.</td></tr>
<tr><th>Hrs</th><th>Focus</th><th>Content, concepts and skills   Enabling Tasks</th></tr>
<tr><td>2</td><td>Investigation skills</td><td>• Learners investigate emergency situations that can lead to refugees:
- Find out what situations commonly result in people becoming refugees.
- Find out what initial problems are typically faced by refugees.
o What mix of people will usually be present?
o What are their needs for shelter? (Shelter will be addressed in the mini-PAT)
o What are their needs for food and water?</td></tr>
<tr><td>2</td><td>Investigation skills

Design skills</td><td>Processing food: emergency food
Investigate the types of food that can be supplied to occupants of a refugee camp.
Design brief: learners write a design brief giving specifications of the types and quantities of food needed for a population of 100 refugees.
• Design: List the ingredients of a meal that will be nutritious as well as tasty, and which can be prepared under conditions likely to be found in a refugee camp.</td></tr>
<tr><td>2</td><td>Making skills

Evaluating skills</td><td>• Write down the sequence of manufacture for the process of preparing one item from the meal described above.
• Learners prepare the item selected above.
• Learners evaluate the item in terms of flavour, texture and nutritional value.</td></tr>
<tr><td>2</td><td>Investigation skills</td><td>Learners investigate clothing worn by people in specialised occupations like the emergency services, e.g. fire department, NSRI or dangerous professions. Learners must investigate the following:
• Find out what textiles are used to make the clothing worn by fire fighters, or
• Find out what textiles are used to make the clothing worn by members of the NSRI.</td></tr>
<tr><td colspan="3">FORMAL ASSESSMENT TASK: Mini-PAT   TOPIC: Processing / Bias in and Impact of technology
CONTEXT: Shelters for Refugees   CONTENT: Properties of materials   [70%]</td></tr>
<tr><td>3

3</td><td>Impact of technology

Indigenous technology

Investigation skills

Design skills

Making skills</td><td>Scenario: Tragic shack fires or natural disasters like floods or earthquakes or political strife may create the need for emergency shelters to be erected for the victims. Learners design and make a simple emergency shelter for disaster victims. The shelter must be sturdy, waterproof, easy to erect and able to house a family of six for a month. Learners must be aware of the importance of health and safety issues.
• Investigate: Learners investigate materials and building techniques used by indigenous people for constructing housing in rural South Africa. Materials used in such construction is typically readily available, appropriate and environmentally friendly.
• Investigate: Learners compare materials and building techniques used by people setting up informal settlements. They compare these materials to those used by indigenous builders in terms of suitability, availability and environmentally friendliness.
• Investigate: Learners find out what chemicals can waterproof a textile like canvas.
• Investigate: Learners find out about the burning characteristics of various textiles
• Design brief: Learners write an appropriate design brief with specifications for producing a textile suitable for use in making an emergency shelter.
• Design: Learners sketch design ideas for an emergency shelter that can be transported to and erected at a site where people have become homeless.
• Make: Learners make a model of an emergency shelter made of a material that they have waterproofed and that is suitable for housing refugees for a period of at least a month. It should be easy to transport, easy to assemble, and easy to pack away after use.</td></tr>
</table>

Formal Assessment: Term 4:	**Weighting: 10% of promotion mark** **Mini-PAT alone: [100%]**
End-of-year examination	**60%**
YEAR MARK : Term1 [7 +3] + Term2 [7+3] + Term3 [7+3] + Term4 [10] = **40%**	
Promotion mark: Year mark (40%) + Final exam mark (60%) = 100%	

3.2 FOCUS CONTENT, CONCEPT AND SKILLS FOR GRADE 8 TERM 1-4

GRADE 8 TERM 1		
It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to. Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.		
Hrs	**Focus**	**Content, concepts and skills** **Enabling Tasks**
2	**Structures** **Investigation skills**	**Frame structures** • Definition of ***frame*** structures. - Purpose of structural members (components) in wood and steel roof trusses (king and queen post, strut, tie, rafter, tie beam). - Learners identify structural members and type of force (shear, torsion, tension, compression) acting on them in given frame structures. • **Case study**: Electrical pylons – use pictures of a range of pylon designs noting: - The variety of designs that solve the same problem effectively. - The use of ***internal*** cross-bracing and triangulation to provide stiffness. • Structural members under tension/compression (worksheet).
2	**Structures**	**Structural members** • Structures that span over space: - Beams: steel I-beams (girders), concrete lintels; beam and column bridge. - Alternative bridge supports: suspension bridges; cable-stayed bridges. - Arches: arches in buildings, bridges, dam walls. - Cantilevers: simple cantilever, cable-stayed cantilever. Structural failure – the three most likely ways structures fail are: - **Fracture** of a member – due to lack of strength. - **Bending** (flexing, buckling) – due to lack of stiffness (rigidity). - **Toppling over** – due to lack of stability (top heavy, narrow base).
4	**Communication skills**	• **Purpose of graphics**: develop and communicate ideas. • **Conventions**: outlines (thick/dark); construction lines (thin/feint); hidden detail (dashed); centre lines (chain dash-dot); scaling up and scaling down; dimensioning (in mm). • **Working drawing** techniques for planning: - Single view flat 2D drawing with dimensions, line types and scale. - Isometric – using underlying isometric grid (term 1) and simple instruments (term 3). • **Artistic drawing:** Double vanishing point perspective with colour, texture and shading. - Sketching – using pencil, ruler and blank paper. - Enhancing drawing to promote realism using colour, texture, shading and shadows.

4	**Mechanical systems and control** **Investigation skills** **Communication skills**	• **Revision**: mechanical advantage. Well-designed machines give "***mechanical advantage***". • All complex machinery consists of combinations of simple mechanisms. - **The wedge:** e.g. inclined plane or ramp, door wedge, knife blade, etc. - **The wheel and axle:** e.g. from bicycle to shopping trolley. • **Gears:** (wheels with wedges for teeth) - Show how meshing of two spur gears causes **counter-rotation**. - Show how introducing an **idler** gear between two spur gears synchronises rotation of the driver and driven gears. **Note**: Since a small idler will rotate more times than the larger gears, it should be made of harder material. - Gear ratios: Show how different sized gears result in a change in the velocity ratio as well as an 'opposite' change in the force ratio – *if force increases, speed decreases, and vice versa.* • Mechanisms that change the direction of movement: - The Cam: show how a cam converts rotary motion into reciprocating motion. Compare an eccentric wheel and a snail cam. - The Crank: an adaptation of a second-class lever. Show how a crank converts rotary motion into reciprocating motion. • **Graphic skills**: learners draw an artist's impression of one of each of the above mechanisms in their books using colour, shading and texture.

FORMAL ASSESSMENT TASK 1: Mini-PAT **TOPIC: Structures / Mechanical Systems and Control** **CONTEXT: To be provided by material developers** **CONTENT: Frame structures with mechanisms** **[70%]**		
7	**Structures** **Evaluation skills** **Design skills** **Making skills** **Communication skills**	Learners work in teams to design and make a structure utilising required structural components and mechanisms to suit the context provided. • **Evaluate**: learners examine information on several complex structures and list advantages and disadvantages in the designs. • **Design**: initial idea sketches. • **Design**: design brief with specifications and constraints. • **Make**: a 3D isometric projection of the idea with dimensions and drawn to scale. • Make: a working drawing in 2D showing one view with dimensions and line types. • Make: teams build their structure housing mechanisms using safe working practices. • Communicate: teams present their plans and model. • Communicate: a sketch in double VP perspective enhanced using two of colour, texture or shading.
1	**Formal Assessment Task:** Test (the test may be before or after the mini-PAT) [30%]	
Formal Assessment: Term 1: **Weighting: 10% of promotion mark** **Mini-PAT: [70%]** **Test: [30%]** **Total: 100%**		

GRADE 8 TERM 2		
It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to. Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.		
Hrs	**Focus**	**Content, concepts and skills** **Enabling Tasks**
2	**Impact of technology** **Processing** **Investigation skills** **Communication skills**	• **The positive impact of technology:** many natural materials have been replaced in modern times by new or improved materials. Some new materials are environmentally friendly by being bio-degradable. • **Case study 1:** investigate the impact of plastic shopping bags on the environment. • **Report**: learners write a report evaluating the effectiveness of using thicker, bio-degradable plastic shopping bags which shoppers must buy.
2	**Investigation skills**	• Case study 2: technology with a positive impact on society. - Investigate how waste paper and cardboard are recycled to produce new products for the packaging industry. • Development: draw a development of an opened container.
2	**Designing skills** **Making skills**	• Practical activity: a product requires packaging. Design and make packaging for a purpose. The nature of the product determines the design and properties of the packaging material. • Learners work safely to make and assemble the above packaging product.
FORMAL ASSESSMENT TASK 2: Mini-PAT TOPIC: Impact of technology / Processing / Structures **CONTEXT: Will be given by materials developers CONTENT: Counteracting effects of negative technology [70%]**		
2	**Impact of technology** **Investigating skills**	• **Case study 3**: technological products can have a <u>negative</u> impact. • Investigate a technological product that can have a negative impact on society. • **Class discussion**: facilitate a class discussion on possible solutions that can counteract or compensate for the negative impact of the technology identified.
2	**Structures** **Processing**	• **Revise:** forces that act on material – tension; compression; bending; torsion; shear. • Adapting materials to withstand forces – reinforcing concrete, plywood. • Selecting metal sections (I-beam, angle iron, T-bar, etc.) to withstand forces and to save material.
2	**Design skills** **Making skills**	• **Design**: learners adapt a material or design a product that will solve the problem or reduce the impact or negative effects of the technology identified. • **Design**: learners sketch free-hand sketches showing two possible solutions. • **Make:** learners draw their chosen solution in 3D using isometric projection. • **Make**: learners make the model/prototype/product they have designed safely.
2	**Making skills** **Evaluation skills**	• **Make (cont.)**: Learners make the model/prototype/product they have designed safely. • **Evaluate**: learners evaluate their solution in terms of its effectiveness in solving or reducing the negative impact of the technology identified. Their evaluation will be assessed in terms of its objectivity, fairness, accuracy and scope (depth).
2	**Communication skills**	• Communicate: Teams present their plans, model and evaluation.
1	**Formal Assessment Task:**	**Term Test** **[30%]**
Formal Assessment: Term 2: Weighting: 10% of promotion mark **Mini-PAT: [70%] Formal Term Test: [30%] Total: 100%**		

GRADE 8 TERM 3			
It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to. Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.			
Hrs	**Focus**	**Content, concepts and skills**	**Enabling Tasks**
2	**Mechanical systems and control**	**Revise: Levers –** single levers and levers linked in pairs. Single first-class lever – mechanical advantage depends on the position of the fulcrum. Linked first-class levers – consider various samples, e.g.: - Paper scissors (if equal length blade and handle) – no mechanical advantage. - Secateurs (long handle and short, strong blades) – mechanical advantage > 1. - Single second-class lever – always gives some mechanical advantage. - Linked second-lass levers – consider various samples, e.g.: - Office punch – mechanical advantage > 1. - Heavy duty stapler – mechanical advantage > 1. - Single third-class lever – never gives any mechanical advantage. - Linked third-class levers – consider various samples, e.g.: - Office light-duty stapler – mechanical advantage < 1. - Pair of tweezers – mechanical advantage < 1. - **Gear systems** – concepts (counter rotation, idler, velocity ratio, force multiplication). - Two spur gears of unequal size – note counter rotation and velocity ratio. - Two spur gears of unequal size – note velocity ratio and force ratio (mechanical advantage < or > 1). - Two spur gears connected via an idler – note synchronised rotational direction. - Suitable materials – the idler needs to be of a harder material than the other gears. - Two bevel gears linked to transfer the axis of rotation through 90^{o}.	
2	**Mechanical advantage calculations**	***Calculate* mechanical advantage (MA)** • **Levers:** mechanical advantage calculations for levers using ratios. • Calculations using LOAD/EFFORT; load ARM/effort ARM; etc. • *Do NOT use the method of "taking moments about a point".* • **Gears:** mechanical advantage calculations for gears using ratios. Calculations using tooth ratios; gear wheel diameters; velocity ratios.	
2	**Communication skills** **Design skills**	**Represent gear systems graphically:** use circular templates and/or pair of compasses to draw gear systems with: • The driven gear rotating in the ***opposite*** direction to the driver (counter rotation). • The driven gear rotating in the ***same*** direction to the driver (include an idler gear). • The driven gear rotating ***faster*** than the driver (with and without an idler). • The driven gear rotating ***slower*** than the driver (with and without an idler). **Design brief**: learners write a design brief with specifications for a device that will use a combination of gears to achieve: • A mechanical advantage with force multiplication of three times. • An increase in output velocity of four times. **Draw**: use an isometric projection using simple instruments (as in Maths Set) to draw sketches showing gear systems that meet each of the two above specifications.	

2	**Design skills** **Investigation skills** **Investigation skills** **Design skills**	**Sketches** (2D) showing gear systems that: Provide an output force four times greater than the input force (MA = 4:1). Provide double the rotation rate on a driven axle at 90° to the driver axle. **System analysis – bicycle gear system** Analysis of the gears used on modern bicycles – terminology: master/slave or driver/driven; chain wheel; cogs. **Systems diagrams** **Analyse** a mechanical system by breaking it into input-process-output. Draw a Systems Diagram for a gear system with a mechanical advantage of 4:1. **Plan** a mechanical system to produce a specific output. Systems diagram for a gear train with the driven gear rotating faster than the driver.
2	**Investigation skills** **Impact of technology** **Indigenous technology** **Bias in technology**	**Learners working in teams investigate and report on ONE of the following:** *Distribute the investigations so **all** are covered and reported in each class.* **Investigate**: The **impact** on the environment as a result of mining of: Acid mine drainage .... OR **Investigate**: The **impact** on the environment as a result of mining of: Dust pollution from mine dumps on residential areas. .... OR **Investigate**: Iron age technology: Indigenous mining of iron in South Africa before the modern era .... OR **Investigate**: Bias in technology: Gender bias in career choice / opportunities related to mining.
FORMAL ASSESSMENT TASK 3: Mini-PAT TOPIC: Structures / Mechanical Systems and Control **CONTEXT: Tendering for Contracts** CONTENT: A STRUCTURE with a MECHANISM for lifting a load **SIMULATION – Tendering for constructing Head-gear for a mine/quarry. [70%]**		
South Africa is a country rich in mineral resources. Mining occurs to some extent in every province of our country, ranging from copper and iron in the Northern Cape and Limpopo, chrome and platinum in Limpopo and North West, gold in Gauteng and Free State, coal in Mpumalanga and KwaZulu-Natal, titanium in the Eastern Cape and phosphate in the Western Cape. In addition, open cast quarrying for road gravel is widely spread throughout the country. Although mining is not evenly distributed in all provinces, the mines and their related industries attract a work force derived from every corner of our country, and impacts the lives – directly or indirectly – of every member of society. We have huge reserves of coal, copper and iron ore. We are the main suppliers of platinum, manganese and chromium in the world. Although it is the source of our nation's wealth, mining is a dangerous, labour-intensive activity that has negative impacts on the environment. The deeper our mines penetrate into the earth's crust (over 4 km), the more dangerous mining becomes since tunnelling through rock under massive pressures leads to "rock bursts" and cave-ins which frequently threaten the lives of miners.		
Scenario: *A commercially viable ore body containing platinum group metals has been found on land belonging to a tribe in rural South Africa. Drill samples have proved that the reef lies at a relatively shallow depth only 500m below surface.* *A decision has been taken to sink a shaft to this depth to conduct bulk sampling on a small scale before deciding on a mining method best suited for the size and value of the resource.* *Your mechanical engineering company decides to submit a tender for the construction of shaft head-gear suitable to transport miners to and from the work level, and for raising ore and waste in loads not exceeding 10 tons at a time.*		
2	**Investigating skills** **Design skills**	**Investigate**: Lifting mechanisms (wire rope-driven mine head-gear) in use at South African mines for raising people and ore. **Sketch**: initial idea sketches to meet the requirements given in the scenario. **Design brief** with specifications and constraints.

4	**Evaluation skills** **Making skills** **Design skills** **Making skills**	**Simulation**: teams form mechanical engineering companies. They **evaluate** sketches of individuals and select the best idea for the team tender bid. **Drawings for the shaft head-gear** – each learner draws a: 3D isometric drawing of the selected design giving dimensions and drawn to scale. 2D working drawing showing one or more views with dimensions and lines. **Budget**: teams prepare a realistic budget detailing expected costs of constructing a real mine shaft headgear, detailing valid prices of materials and labour costs of the range of workers who would be involved in designing and building such a device. **Make**: teams build their working scale model using safe working practices.
2	**Communication skills:**	**Communicate**: teams present their tender proposal for the mine shaft headgear (research, plans, flow chart, model and budget) to the "Tender Board".
1	**Formal Assessment Task:**	**Test** (Note: the test may be written before the Mini-PAT) **[30%]**
Formal Assessment: Term 3:	**Weighting: 10% of promotion mark**	**Mini-PAT: [70%]** **Test: [30%]** **Total: 100%**

<table>
<tr><th colspan="3">GRADE 8 TERM 4</th></tr>
<tr><td colspan="3">It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to.
Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.</td></tr>
<tr><th>Hrs</th><th>Focus</th><th>Content, concepts and skills Enabling Tasks</th></tr>
<tr><td>2</td><td>Electrical systems and control

Design skills</td><td>• Revise: simple circuit components; input devices (electrochemical cell; generator; solar panel), output devices (resistor; lamp; heater; buzzer; motor); control device (switches). Note: Some devices can serve as input, output, process or control device.
• Correct connections, short circuits. Electrical components and their accepted symbols.
• Drawing electrical circuits using accepted symbols (as in Grade 12 see Addendum C).
• Set up circuits using a range of components. Draw the circuits using symbols.</td></tr>
<tr><td>2</td><td>Impact of/bias in technology

Evaluation skills
Bias in technology</td><td>• Energy for heating, lighting and cooking in rural and informal settlements.
• Energy from illegal connections; ethical issues; safety considerations.
• Class discussion: equitable sharing of resources – industry needs reliable power for job creation; schools need power for lighting and computing.
• Written report: Learners write a balanced report on these issues.</td></tr>
<tr><td>2</td><td>Electrical systems and control
Impact of technology</td><td>• Electrochemical cells.
• Practical: make your own batteries – fruit, vegetable and salt water batteries.
• Advantages and disadvantages of series and parallel batteries.
• Photovoltaic cells - advantages and disadvantages of solar cells.</td></tr>
<tr><td>2</td><td>Electrical systems and control

Impact of technology</td><td>• Generate electricity for the nation – advantages and disadvantages of:
Thermal power stations (steam turbines – sources of heat: coal, gas, nuclear, sun).
Hydroelectric power stations (including pumped storage schemes).
Wind-driven turbines.
Alternating current; step-up and step down transformers; distributing electric power across the country: the national grid.</td></tr>
<tr><td colspan="3">FORMAL ASSESSMENT TASK 4: Mini-PAT TOPIC: Electrical Systems and Control
Context: Will be given by materials developers CONTENT: Logic Gates [70%]</td></tr>
<tr><td colspan="3">Scenario: EITHER
Crime is a problem facing every community in South Africa. Criminals invade homes especially where women, children or the elderly are often vulnerable and defenceless. Armed response companies can be summoned to the scene by alarms triggered by panic buttons placed strategically in the house. Learners must find out about AND & OR logic gates and select the appropriate logic for wiring a panic button.
OR
Any other relevant context involving logic gates, e.g. vending machines, etc.</td></tr>
<tr><td>2</td><td>Design skills

Investigation skills</td><td>• Practical: learners draw circuit diagrams AND connect circuits showing the effect of circuits with resistors connected in series and parallel.
• Investigation: introduce Ohm's Law (qualitatively – no calculations). Learners use one cell, then two cells, and then three cells connected in series and note the effect on the brightness of a lamp. They must conclude that more cells in series (more voltage) will cause the current strength to increase, if the resistance does not change.</td></tr>
<tr><td>2</td><td>Investigation skills</td><td>• Investigation: AND logic gate and simple cases where it is used.
• Investigation: OR logic gate and simple cases where it is used.
• Lesson: truth tables for AND & OR logic conditions.</td></tr>
<tr><td>2</td><td>Design skills

Making skills

Communication skills</td><td>• Design brief: learners write a design brief giving specifications for a suitable panic button system OR scenario given by the textbook.
• Circuit diagram: draw the circuit diagram using correct symbol conventions.
• Make: connect the components specified to form a circuit suitable for at least two switches.
• Communicate: learners draw the truth table for the device.
• Communicate: learners prepare an advertising poster for their device.</td></tr>
<tr><td>1 ½</td><td colspan="2">Year-end Examination</td></tr>
</table>

Formal Assessment: Term 4:	**Weighting: 10% of promotion mark** **Mini-PAT alone: [100%]**
End-of-year examination	**60%**
YEAR MARK : Term1 [7+3] + Term2 [7+3] + Term3 [7+3] + Term4 [10] = **40%**	
Promotion mark: Year mark (40%) + Final exam mark (60%) = 100%	

3.3 FOCUS CONTENT, CONCEPT AND SKILLS FOR GRADE 9 TERM 1-4

GRADE 9 TERM 1: STRUCTURES		
It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to. Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.		
Hrs	**Focus**	**Content, concepts and skills** **Enabling Tasks**
2	**Design skills**	• First angle orthographic projection: three-dimensional objects on flat paper. - Concept of drawing three different views: front, top and side. Simple cubes. - Line types: dark, feint, dashed, wavy, chain. Scale and dimensions.
2	**Design skills**	• More complex 3D objects drawn in orthographic projection with instruments. **Design problem**: flight of stairs and wheelchair ramp. - Design brief specifying number of steps, height of stair risers, width and gradient of ramp, handrail, etc. - Sketch the stair and ramp in 3D using isometric projection. - Draw a plan for the stair and ramp using first angle orthographic projection to an appropriate scale, using correct views, line types and dimensions according to convention.
NB: These skills should be developed **progressively** with each task. Do not spend more than the time allocated for this **introduction**. By the end of the year the learners should have developed the required level of competence. Level required after week 2 – learners should be able do the following at an elementary level: • Learners draw a plan for an object of a given size. They use the first angle orthographic technique using correct line types, drawn to scale with dimensions. • Learners design a solution to solve a given problem and draw a ***suitable*** plan using first angle orthographic. NB: It is most important that the ***plan can work***. If the solution will not solve the problem it must be penalised, no matter how neatly it is drawn.		
2	**Structures**	• Forces can be static or dynamic, and loads can be even or uneven. - Strength of materials under the action of forces – metal cross-sections: - Tension (pulling); compression (pushing); bending of beams (compression and tension). - Torsion – using internal cross-bracing to resist twisting. • Properties of various construction materials: mass/density; hardness; stiffness; flexibility, corrosion resistance and prevention of corrosion.
FORMAL ASSESSMENT TASK 1: Mini-PAT TOPIC: Structures **CONTEXT: Community Issues – The Contractors CONTENT: Identifying a problem within a given scenario [70%]**		
Task1: SIMULATION: Structures (Grade 9 learners must be able to identify a problem from a given context) This task deals with the design of a structure that will solve a problem facing a community living on the far side of a river from the city. The local authority places an advertisement inviting contractors to submit tenders for a solution. **Learners form teams to act as 'Contracting Companies' which will compete for the contract to solve the problem**. **The teams must be structured, with carefully designed roles for every learner.** ***Rationale***: *You do not need to be a member of a community in order to be able to address their needs – engineering firms build bridges and stadia all over the world, and an architect can design an RDP house without having to live in it.* *This task allows learners to* ***simulate*** *the way the world works with companies bringing appropriate technological solutions to problems wherever they need to be solved. A number of problems may be identified and a range of solutions may work.* *Costing is also part of design and learners at this level should consider real costs, including labour – as this will help them to make informed career choices at this key point in their education, with subject choices for FET especially important.*		
2	**Investigation skills**	The tender process (including ethical practices). • **Investigate:** provide the scenario so that learners can investigate the problem situation and various possible structures which could solve the problem(s) they identify. Analysis of existing products relevant to the identified problem in terms of fitness-for-purpose (including suitability of materials), safety for users, costs of materials and costs of construction. Realistic costs of real materials, labour, transport, etc. Textbook writers must supply useful resources for this.

2	**Design skills**	• **Sketch** initial ideas: each learner generates two possible ideas. • **Evaluate and adapt**: teams evaluate individual ideas and develop a final idea. • **Design brief**: learners write a design brief with specifications for the final idea. • **Flow chart**: teams discuss how to proceed, then each learner draws a flow chart.
2	**Making skills** **Costing**	• **Working drawings**: each learner draws the plan (or an aspect of the plan) using first angle orthographic projection with suitable scale, correct line types and dimensions. • **Budget:** costing of the "real-life" solution, including correct materials and labour costs.
2	**Making skills**	• **Model of a viable solution:** It must be built neatly to scale, showing intelligent use of materials. Learners must use safe working practices.
4	**Evaluation skills** **Communication skills**	• **Evaluate:** teams collaborate to produce an evaluation instrument. Each learner uses the instrument to evaluate their team's solution and that of another team. This can be done during the other team's presentation. • **Team presentations:** teams present their tender bid to the "Tender Board". Each team member must be responsible for an aspect of the presentation. Tenders consist of sketches, plans, budget, model and artistic impressions.
1	**Formal Assessment Task:**	**Test** (Note: the test may be written before the Mini-PAT) **[30%]**
Formal Assessment: Term 1:		**Weighting: 10% of promotion mark** **Mini-PAT: [70%]** **Test: [30%]** **Total: 100%**

GRADE 9 TERM 2: MECHANICAL SYSTEMS AND CONTROL

It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to. Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.

Hrs	Focus	Content, concepts and skills Enabling Tasks
2	**Mechanical systems and control** **Investigation skills**	• **Revise**: syringe mechanics using two equal sized syringes linked by a tube. Force transfer between the syringes filled with: - Compressed air – pneumatic system. - Water – hydraulic system. • **Action research**: learners experiment with two <u>different sizes</u> of syringes linked by a tube and filled with hydraulic fluid (water). Learners ***experience*** force transfer with either force multiplication or force division (depending on which syringe is the driver/master). Gases (like air) are compressible. Liquids (like water, oils) are incompressible. • **Action research**: Pascal's principle – *pressure exerted on one part of a hydraulic system will be transferred equally, without any loss, in all directions to other parts of the system*. Note that equal volumes of liquid are moved through the systems, and this results in different extensions (amount of movement) where syringes (cylinders) are of different sizes, so less distance/more force (MA > 1); and more distance/less force (MA < 1).
2	**Investigation skills**	• The hydraulic press (including simple calculations). • The hydraulic jack. • **Investigation:** Design considerations ~ fit-for-purpose: - Evaluate the design of the hydraulic jack in terms of: Who is it for? What is it for? Will it do the job? What should it be made of? What should it cost? Is it cost-effective? Does it look good (aesthetics)? Is it safe/easy to use for the end user (ergonomics)? • Draw a systems diagram which describes the way a hydraulic jack works.
2	**Investigation skills** **Mechanical systems and control**	• **Action research**: practical investigations: - Use a single wheel ***fixed*** pulley to change the direction of pull (MA = 0). - Use a single wheel ***moveable*** pulley to change the direction of pull (MA > 0). - Use a pulley block system (block and tackle) to determine the relationship between load-bearing ropes on moveable pulley wheels and M.A (force multiplication). • **Investigate**: learners find out about the following mechanical control systems: - Ratchet and pawl. - Disc brake. - Bicycle brake. - Cleat.
2	**Mechanical systems and control**	• Lead learners as they **revise** the interactions of the following: - Spur gears of equal size counter-rotating. - Spur gears of unequal size counter-rotating – note velocity/force relationships. - Spur gears using an idler to synchronise rotation. • Lead learners as they find out about the interactions of the following: - Bevel gears of equal size – axis of rotation 90^o. - Bevel gears of unequal size – axis of rotation 90^o – note velocity/force relationships. - Rack-and-pinion gear system as found on automatic gates and steering racks. - Worm gear system for large reduction in speed and increase in force.

2	**Evaluation skills** **Design skills** **Communication skills**	• **Evaluate**: learners examine various items using mechanisms found in the modern kitchen and/or home, workshop/garage. Items like can openers, egg beaters, 'strap' spanners for opening bottles, knives for a range of purposes, and vice grip, wire strippers and ratchet spanners should be evaluated in terms of: Who is it for? What is it for? Will it do the job? What material is it made of? Is the material suitable? What should it cost? Does it look good? Is it safe and easy to use? They report on three items. • **Artistic Drawing**: single vanishing point perspective. - Learners draw a 3D wooden object using single VP perspective. They enhance the drawing showing the texture of the wood grain, colour and shadows. - Learners use single VP perspective to draw an inside view of the classroom.
FORMAL ASSESSMENT TASK 2: Mini-PAT TOPIC: Integrated Systems – Mechanical / Electrical / Other **CONTEXT: Will be given by materials developers CONTENT: Problem Solving / Mechanical Advantage [70%]**		
INTRODUCING THE PRACTICAL TASK: **Integrated Systems** *Duration of this lesson is one 30-minute period*. Systems where **mechanical, electrical, hydraulic or pneumatic** systems are combined. **Scenario**: Describe a scenario where a machine combining at least two of the following sub-systems can be effective in giving a mechanical advantage to make work easier: mechanical, electrical or pneumatic/hydraulic systems. **Note**: The mechanical elements may consist of one or more of the following mechanisms: levers, linked levers, wheels, cams, cranks, pulleys and/or gears. The machine may include a mechanical or electrical control device like a cleat, ratchet and pawl, or switch.		
2	**Investigation skills** **Design skills**	• **Investigate** the *situation* so that an appropriate machine can be designed to solve the problem, need or want given in the scenario. Investigate the *possible mechanisms and controls* to be used together to make the machine. • **The design brief:** each learner writes his/her suggestion for the design giving specifications and constraints. • **Sketches:** each learner produces two sketches of viable possible designs. Teams meet and examine the individual suggestions and then decide on a final solution.
3	**Making skills**	• **Plan: working drawings** The teams collaborate to produce drawings for their model/prototype using first angle orthographic projection. Each team member draws a plan of the design OR, if it is very complex, one or more aspects of the design. Each learner must demonstrate her/his competency in using this drawing technique. • **Make: prototype/working model** Learners use safe working practices. Building: the model must showcase a viable solution to the problem. It should be to scale and neat, and show intelligent use of available materials.
2	**Communication skills**	• **Team presentations**: Each team is given five minutes to present their solution in the form of sketches, artistic impressions of the solution, working drawings/plans, costing and their model.
1	**Formal Assessment Task:**	**Term Test** **[30%]**
Formal Assessment: Term 2: **Weighting: 10% of promotion mark** **Mini-PAT: [70%] Formal Term Test: [30%] Total: 100%**		

GRADE 9 TERM 3: ELECTRICAL / ELECTRONIC SYSTEMS

It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to. Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.

<table>
<tr><th>Hrs</th><th>Focus</th><th>Content, concepts and skills</th><th>Enabling Tasks</th></tr>
<tr><td>2</td><td>Electrical systems and control

Investigation skills</td><td>Revise 1 – component symbols:
• Cells in series and parallel.
• Lamps in series and parallel.
• Switches in series (AND logic) and parallel (OR logic).
• Current in the circuit – conventional current flows from positive to negative.
Revise 2 – simple circuits:
• One cell, switch, two lamps in series.
• Two cells in series, switch, two lamps in series.
Ohm's law quantitatively: as voltage increases, current increases if resistance is constant.
Action research: testing Ohm's Law practically – measure the voltage (potential difference) and the current strength in each of the following circuits:
• One cell connected to a 20W resistor – note the voltmeter and ammeter readings.
• Two cells connected to the 20W resistor – note the voltmeter and ammeter readings.
• Three cells connected to the 20W resistor – note the voltmeter and ammeter readings
• Plot the readings on a graph and determine the relationship between potential difference and current strength while keeping the resistance constant.</td><td></td></tr>
<tr><td>2</td><td>Electrical systems and control</td><td>Resistor colour codes:
• Low value resistors often have their resistance value printed on them in numbers.
• Higher value resistors are coded using coloured bands. The first three bands give the value of the resistor in ohms. The fourth band is an accuracy rating as a percentage.

Calculate values:
$R = \frac{V}{I}$ use to calculate R if V and I are known.
$V = IR$ use to calculate V if I and R are known.
$I = \frac{V}{R}$ use to calculate I if V and R are known.

Note: R - represents the resistance of a resistor in ohms .... [Ω].
V - represents the potential difference in volts .... [V].
I - represents the current strength in amperes .... [A].</td><td></td></tr>
<tr><td>4</td><td>Electronic systems and control</td><td>• Switches: Manual switches controlled by the user, e.g. push, SPST, SPDT, DPDT.
• Diodes and LED (Light Emitting Diode):
- A diode is a component that allows current to flow in one direction only.
- A LED allows current to flow in one direction only and also gives off light and is often used as an indicator that a circuit is 'ON'.
• Transistors: only npn-type will be used at this level.
- A transistor is a device that can act as a switch and it can amplify a small current (e.g. from a sensor) into a larger current.
- Connect a simple transistor circuit.
Sensors – important input devices:
• LDR (Light Dependent Resistor) – a component whose resistance decreases with light [dark – high resistance; bright light – low resistance].
• Thermistor: a component whose resistance varies with temperature. Two types exist:
- + t: resistance increases with increasing temperature.
- - t: resistance decreases with increasing temperature.
• Touch or moisture detector: a component that can be bridged using a 'wet' finger, thus completing the circuit, indicating the touch.
• Capacitors: a component which can store and then release electrical energy.</td><td></td></tr>
</table>

2	**Electronic systems and control**	**Simple electronic circuits**: Learners **draw**, AND work in groups to assemble these simple electronic circuits: LED, 470Ω resistor, switch, and 4,5V series battery. LDR, buzzer, 3V series battery. NPN transistor, buzzer or bell, thermistor, variable resistor, 1kΩ resistor, 6V series battery (or DC power supply or photovoltaic panel). 6V series battery, LED, 470Ω resistor, 1 000μF capacitor, switch.
Short Practical Assessment Task: "Mini-PAT"	**Innovation: Electronic Systems and Control**	**[70%]**
PRACTICAL TASK: **Electronic Systems** **Setting the scene** *Duration of this lesson is one 30-minute period.* Systems where **electrical and electronic** systems are combined. This may be integrated with other aspects like **structures**, etc. Learners will not be expected to ***design*** an electronic circuit. They will assemble and connect the components of a given circuit and will design a suitable application for that circuit. The electronic circuit may contain sensor devices and/or use transistor(s). **Scenario**: describe a situation where a given electronic circuit can be used to meet a need. Learners are given the task of building a given electronic circuit and finding an appropriate use for this circuit.		
2	**Investigation skills** **Design skills**	• **Investigate** the situation and the nature of the need so that an appropriate circuit can be chosen to solve the problem, need or want given in the scenario. • A given circuit must be incorporated into the design of a device that will use the electronics to address the problem, need or want. • **The design brief**: Each learner writes his/her suggestion for the design with specifications & constraints. • **Sketches** Each learner draws the circuit diagram. Each learner produces a sketch in 3D showing the device that will use the electronic circuit. • Teams meet and examine the individual suggestions to decide on a final solution.
2	**Making skills**	• **Plans: working drawings** • The learners produce plans for their device/model/prototype using first angle orthographic projection. The plans should include a 3D "assembly" drawing in exploded view showing how the model fits together. • Each team member draws a working drawing of the design OR an aspect of the design. • **Make: device /prototype/working model** • The model must showcase a viable solution to the problem. It should be to scale and neat, and show intelligent use of available materials.
2	**Communication skills**	• **Team presentations**: Each team is given five minutes to present their solution in the form of sketches, artistic impressions of the solution, working drawings/plans, costing and their model.
2		• Each learner compiles a record of his/her own individual contribution to the task. This should be reflected in each learner's **workbook**.
1	**Summative assessment**	**Test (The test may precede or follow the mini-PAT)** **[30%]**
Formal Assessment: Term 3: **Weighting: 10% of promotion mark** **Mini-PAT: [70%]** **Test: [30%]** **Total: 100%**		

<table>
<tr><th colspan="3">GRADE 9 TERM 4: PROCESSING</th></tr>
<tr><td colspan="3">It is compulsory to cover the given scope in the term indicated. The sequence of the work within the term must be adhered to.
Skills – investigating, drawing, designing, making and presenting should improve progressively from term to term.</td></tr>
<tr><td>Hrs</td><td>Focus</td><td>Content, concepts and skills Enabling Tasks</td></tr>
<tr><td>2</td><td>Processing</td><td>Preserving metals (first two methods theoretically, 1.3 <u>practically</u>)
1.1. Painting | 1.2. Galvanising | 1.3. <u>Electroplating</u></td></tr>
<tr><td>2</td><td>Processing
Indigenous technology</td><td>Preserving food (first two methods theoretically, 2.3 <u>practically</u>)
2.1. Storing grain 2.2. Pickling <u>2.3. Drying and/or salting</u>
Note: The drying/salting process will take time and be evaluated when completed.</td></tr>
<tr><td>2</td><td>Processing
Investigation skills</td><td>• Types of plastics and their uses
• Investigation: identification of plastic identifying-codes and sorting for recycling.
Properties of plastics
Reduce – reuse – recycle</td></tr>
<tr><td>2</td><td>Processing
Investigation skills</td><td>• Case study: Remanufacturing waste plastic into pellets for re-use.
• Systems diagram: Draw a systems diagram describing a plastics recycling project.
• Case study: Moulding recycled plastic pellets into products.</td></tr>
<tr><td colspan="3">Formal Assessment Task: Mini-PAT Reduce - Reuse - Recycle [70%]</td></tr>
<tr><td colspan="3">PRACTICAL TASK: Working with Plastics Setting the scene Duration of this lesson is 30 minutes.
Scenario: Describe a situation where cutting, joining, bending AND/OR moulding plastics can be used to make a plastic product that will satisfy a need, want or opportunity.</td></tr>
<tr><td>2</td><td>Investigation skills</td><td>• Case study: plastics used on modern motor cars.
• Case study: plastics used around the home.
• Problem identification: learners identify a need or want that can be satisfied by the making of a plastic item of their own design.</td></tr>
<tr><td>2</td><td>Design skills
Making skills</td><td>• Sketch: learners sketch their plastic item using isometric projection on grid paper.
• Plan: learners draw their plastic item using first angle orthographic projection.
• Skills development: learners practise the skills needed to manufacture their plastic item – measure, mark out, cut, bend and join. Moulding is an optional extra.</td></tr>
<tr><td>2</td><td>Making skills
Communication skills</td><td>• Practical sessions: working safely, learners measure, mark out, cut and bend the materials for their plastic item, and then assemble the product.
• Each learner compiles a record of his/her term’s work including extending the lifespan of metals and food, properties and uses of various plastics, the plastics recycling strategy, the case studies, and the sketches and plans for the plastic item.</td></tr>
<tr><td>2</td><td>Final examination</td><td>• Summative year-end examination covering knowledge, drawing skills, design issues, and values covered during the Grade 9 year. Questions should be balanced across Bloom’s Taxonomy BUT with special emphasis on application of knowledge in a problem-solving context, as this is the essence of this learning area.
NB: Recall of knowledge without understanding is of little value in Technology.</td></tr>
<tr><td colspan="3">Formal Assessment: Term 4: Weighting: 10% of promotion mark
Mini-PAT alone: [100%]</td></tr>
</table>

<table>
<tr><td colspan="5">End-of-year Examination = 60%</td></tr>
<tr><td colspan="5">YEAR MARK : Term1 [7+3] + Term2 [7+3] + Term3 [7+3] + Term4 [10] = 40%</td></tr>
<tr><td colspan="5">Promotion mark: Year mark (40 %) + Final exam mark (60%) = 100%</td></tr>
<tr><td colspan="5">Grades 7, 8 and 9 Formal Assessment: (4 Tasks)</td></tr>
<tr><td>Term 1</td><td>Term 2</td><td>Term 3</td><td>Term 4</td><td>Promotion Mark</td></tr>
<tr><td>Mini-PAT 70%
TEST 30%</td><td>Mini-PAT 70%
TEST 30%</td><td>Mini-PAT 70%
TEST 30%</td><td>Mini-PAT 100%</td><td>Year mark: 40%
Final exam: 60%</td></tr>
<tr><td>7 + 3</td><td>7 + 3</td><td>7 + 3</td><td>10</td><td>Exams 20% + 40% = SBA 60%</td></tr>
<tr><td colspan="5">Total: 100% (See Table 1 on page 30)</td></tr>
</table>

SECTION 4: ASSESSMENT IN TECHNOLOGY

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: generation and collection of evidence of achievement; evaluation of this evidence; recording of the findings and use of this information to understand and thereby assist the learner's 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.

In a subject with a significant practical nature, like Technology, it is important to develop and assess the skills and values together with the associated subject knowledge. In Technology, knowledge without the skills that are needed to implement a practical solution has little worth. Similarly, skills cannot be taught without the knowledge needed to **design** solutions to problems or to satisfy needs, which is the ***essence*** of the Technology subject.

4.2 BARRIERS TO LEARNING AND ASSESSING

- Although there are many barriers to learning, teachers need to identify and build on learners' strengths in order to affirm their uniqueness. **All learners need to experience success**.
- Alternative strategies must be applied: more time, enlarged text, use of information communication technology, amanuensis or scribes in cases of learners with special educational needs.
- The use of alternative assessment relates to the change in the form of assessment used to accommodate all learners. It is important to vary the assessment strategy appropriately.
- Personal involvement by learners with tasks often improves their attention span, patience, persistence and commitment.
- Designing and making real products that can be used can give learners a sense of achievement and improve their self-esteem.
- The following strategies, depending on the physical barriers of LSEN learners, could apply when supporting:
    - Use the support of others to help pupils take part safely in practical work, for example the assistance of adults or other learners to help with holding or manipulating tools or carrying out activities according to instructions. It is important that the learners retain control of the making process and be the decision makers.
    - Learners can describe their design ideas for others to record or to translate into a drawing, while still retaining control of the design idea and the modifications.
    - Work on shorter, more focused tasks, rather than longer, open tasks. Doing so can provide learners with incremental elements of success and regular motivation and reward.
    - Use ICT applications, such as specialist software, to help with sequencing and following instructions during practical work.

- Use modelling, role-play, tape recorders, video and photographs to communicate, develop and record their ideas.
- Communicate using a range of methods avoiding over-reliance on the written word.

4.3 INFORMAL DAILY ASSESSMENT

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

Informal assessment is a daily monitoring of learners' progress in developing a knowledge base together with the related skills and safe attitudes needed in practical subjects. This is done through observation, discussion, 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 or intervening to demonstrate the correct and safe handling of a tool. 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. In Technology the "enabling" activities that precede the Mini-PAT are intended to develop the knowledge, skills and values to the point where the learners are ready to be assessed formally (this is analogous to the "learner" stage preceding the driver's licence test). Assessment for learning must be developmental. Learners or teachers can mark these enabling tasks.

Self-assessment and peer assessment actively involve learners in assessment. This is important as it allows learners to learn from and reflect on their own performance. The results of 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.

4.3.1 Formal assessment

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 variety and appropriate standards required for the grade 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 and gives insight into the success of the teaching strategy and methodology. Examples of formal assessments are 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, and should be adapted to meet the needs of inclusivity where necessary.

The formal assessment requirements for Technology are as follows:

- Formal assessment for Technology will consist of the Mini-Practical Assessment Tasks and pen and paper tests or examinations.
- **At least 40 out of the 70 Mini-PAT marks per term must be attributed to Practical Work.**
- Tasks done by learners for formal assessment purposes should be monitored by teachers at all times.

- Work done "off-campus" outside the direct control of the teacher should normally not form part of the formal assessment record.
- The end of year promotion mark will comprise **40% CASS** and **60% (Mini-PAT 20% examination 40%) end of year examination:**

<table>
<tr><th colspan="7">Table 1: Formal Assessment in Technology – Grades 7, 8 and 9</th></tr>
<tr><td rowspan="3"></td><td rowspan="2">INFORMAL DAILY ASSESSMENT</td><td colspan="5">FORMAL ASSESSMENT : TERM MARKS</td></tr>
<tr><td colspan="4">Practical Tasks and Theory Test / Examination</td><td>TOTAL</td></tr>
<tr><td>Enabling Tasks</td><td colspan="2">Mini-PAT</td><td colspan="2">Term Test / Examination</td><td>Term Mark</td></tr>
<tr><td>Term 1</td><td rowspan="4">0%</td><td colspan="2">70%</td><td colspan="2">30%</td><td>100%</td></tr>
<tr><td>Term 2</td><td colspan="2">70%</td><td colspan="2">30%</td><td>100%</td></tr>
<tr><td>Term 3</td><td colspan="2">70%</td><td colspan="2">30%</td><td>100%</td></tr>
<tr><td>Term 4</td><td colspan="2">70 marks = 100%</td><td colspan="2">No Test</td><td>100%</td></tr>
<tr><td rowspan="4">Promotion Mark</td><td colspan="2">CASS Component: 40%</td><td colspan="3">Final Examination Component: 60%</td><td rowspan="2">Promotion</td></tr>
<tr><td colspan="2">Continuous Assessment :
Test and Mini-PATs 40</td><td colspan="2">Combined Mini-PAT: 20</td><td>Examination: 40</td></tr>
<tr><td colspan="2">Term 1 + Term 2 + Term 3 + Term 4</td><td colspan="2">T1 + T2 + T3 + T4</td><td rowspan="2">40</td><td rowspan="2">100</td></tr>
<tr><td colspan="2">10 + 10 + 10 + 10</td><td colspan="2">5 + 5 + 5 + 5</td></tr>
</table>

This breakdown is in line with the FET practical subjects where the PAT mark is included as part of the final examination component. In FET, the PAT mark contributes 1/3 of the final exam mark, i.e. 25 out of 75.

The above breakdown ensures that Technology in the GET band retains its focus on practical aspects. However, since GET Technology is not specialising as happens in FET, there are four mini-PATs that need to be added together in equal portions to provide the practical examination component. As with the FET practical subjects, the combined mini-PAT marks contribute 1/3 to the final exam mark, i.e. 20 out of 60.

The forms of assessment used should vary and be age- and developmental level–appropriate.

The design of these tasks should cover the content of the subject and should include a variety of tasks designed to achieve the theoretical and practical objectives of the subject.

Formal assessments must cater for a range of cognitive levels and abilities of learners.

- Cognitive level weighting for tests and examinations: Grades 7–9

RECALL	UNDERSTANDING	APPLICATION	ANALYSE	SYNTHESISE	EVALUATE
ROUTINE	DIAGNOSTIC	STRATEGIC	INTERPRET	CREATE	
Low Order	Middle Order		Higher Order		
30%	40%		30%		

Refer to Annexure G for key words related to Cognitive levels.

Refer to Annexure H for a moderation tool for assessment.

4.3.2 Mini-Practical Assessment Task (Mini-PAT)

Definition: a set of short **practical** assessment tasks which make up the main formal assessment of a learner's skills and application of knowledge during each term. It may be an assignment covering aspects of the design process, or it may be a full capability task covering all aspects of the design process (IDMEC). It is composed of a variety of forms of assessment suited to the range of activities that make up a mini-PAT.

Purpose: a mini-PAT is intended to formalise the practical component of Technology contextualised within a knowledge focus. Practical activities should make up at least 40% of a Mini-PAT's mark allocation.

- The mini-Practical Assessment Task is designed to give learners the opportunity to develop and demonstrate their levels of ability (i.e. capability) as they progress through the task's activities.
- Each mini-PAT focuses **primarily** on one of the knowledge foci of Technology (viz. structures, mechanical systems and control, electrical/electronic systems and control and processing), but may be **integrated** and may target more than one knowledge focus. Textbook writers are expected to develop the mini-PATs.
- These tasks are structured according to the design process:

  Investigate – Design – Make – Evaluate – Communicate.

  NB: *This is NOT a LINEAR process happening in a fixed sequence*.
- Assessment in a mini-PAT need not cover all aspects of the design process each term.
- A mini-PAT is an extended formal assessment task and must be planned with other school activities.

The table below provides a guide for the mini–PAT per term per grade:

Table 2: Focus of the Mini-PAT

	TERM 1	TERM 2	TERM 3 Capability Task	TERM 4
GRADE 7	• **Mini-PAT:** *Mechanical systems and control* Design + Make	• **Mini-PAT:** *Structures* Investigate + Design + Make	• **Mini-PAT** *Electrical / Structures / Mechanisms* Investigate + Design + Make + Evaluate + Communicate	• **Mini-PAT:** *Processing* Design + Make
GRADE 8	• **Mini-PAT:** *Structures / Mechanical systems and control* Communicate + Design + Make	• **Mini-PAT:** *Impact of Technology* *Processing* Investigate+ Design + Make	• **Mini-PAT** *Mechanical systems and control / Structures* Investigate + Design + Make + Evaluate + Communicate	• **Mini-PAT:** *Electrical systems and control* Design + Make
GRADE 9	• **Mini-PAT:** *Structures* Communicate + Design + Make	• **Mini-PAT:** *Mechanical systems and control* Investigate + Design + Make	• **Mini-PAT** *Electronic systems and control* Investigate + Design + Make + Evaluate + Communicate	• **Mini-PAT** *Processing* Design + Make

- A learner must present the full design process once as a mini-Practical Assessment Task in term 3 of each grade. This meets the requirement of one project per subject per annum.
- The preferred tool to be used to assess learner performance in a mini-Practical Assessment Task is an **analytical rubric. (Refer to page 44.)**
- Teachers will assess skills and values using analytical rubrics which should have clear descriptors for each level. This means that a descriptor should say why an achievement is deemed to be, say, 'meritorious' or 'elementary'.
- Schools must take responsibility for providing resources (both tools and materials) needed during the mini-PAT.
- Learners must complete the mini-PATs for formal assessment under teacher supervision.
- Teachers will assess the mini-PATs formally.

NOTE:

Problem Solving Taxonomy by Plant, *et al*. is more applicable as a guide to assessing capability in Technology education. In Plant's approach, the cognitive level is determined by previous experience of learners. This fits well with the skills development in Technology where learners are expected to get progressively better through the year.

Problem Solving Taxonomy **(Plant *et al.*, 1980)**

5. **Creativity level:** Tasks require learners to **develop a solution** which was not previously known or to combine a few procedures in a new way.
4. **Interpretation level:** Learners are required to **simulate a real life problem** and solve it. Learners reflect the result back to a real-world problem and implement its solution.
3. **Strategic level:** Problems which require learners to **select the most suitable solution** out of a number of possible correct known options.
2. **Diagnostic level:** Tasks which require learners to **choose the correct routine** out of a few known possibilities.
1. **Routine level:** Problems which require learners to **follow familiar routine process**.

Table 3: Content weighting for tests and examinations: Grades 7–9		
Investigate, design, make, evaluate and communicate **Design Process Skills:**	Structures, Processing, Mechanical and Electrical/Electronic Systems and Control **Knowledge:**	(Technology, Society and the Environment) Indigenous / Impact / Bias **Values and Attitudes:**
50%	**30%**	**20%**

NB: The above **weighting for assessment** should ***guide the approach to teaching*** in Technology. Most of the knowledge will be acquired purposefully during the development of design process skills. For example, learners will ***investigate*** required knowledge aspects, and will ***evaluate*** the possible impact on society or the environment.

AN EXAMPLE OF A GENERIC ANALYTICAL RUBRIC TO ASSESS DESIGN CAPABILITY IN A MINI-PAT

The learner is able to:					
	LEVELS OF COMPETENCE				
	EXEMPLARY	**COMPETENT**	**DEVELOPING BUT NOT YET MASTERING**	**PROGRESSING**	
	5	**4**	**3**	**2**	**1**
Generate and develop design ideas	Uses drawings reflectively to generate new ideas	Progression of ideas across or within drawings	Design ideas are generated but not developed	Simple sketch showing object to be made	Drawing a picture not designing a product
Explore the possibilities of the problem/ need	Combining novel solutions to produce innovative design	Using drawings to develop novel design solution(s)	Recording possible creative solution(s) to the task	Stereotypical response, showing little creative thought	Design possibilities are not addressed in the drawing
Address the constraints of the problem/ need	Task constraints treated as part of iterative process	Task constraints considered as the design proceeds	Records way to address task and/ or client needs and wants	Drawings shows some understanding of task constraints	Minimal understanding of task/user needs
Plan the look of the product	Ideas about finishing develop within overall designing	Ideas about finishing are added to design whilst drawing	Overall decoration scheme considered	Little consideration of final appearance of product	Appearance of the product is not considered
Communicate design ideas	Clear enough for somebody else to make the product	Conveys sense of the object to be made, e.g. working diagram	Conveys some sense of the object to be made, e.g. indicates materials	Simple unlabelled sketch(es); relying on shared meanings	Use of narrative or other drawing genre
Plan construction	Constructional issues considered on route to final design	Drawing demonstrates consideration of construction	Drawing indicates some consideration of construction	Minimal consideration of construction whilst drawing	Not planning to make the object drawn
Evaluate while drawing	Changes made a result of considering design drawings	Decisions made about product whilst drawing	Considered and rejected a range of ideas	Minimal evaluation at drawing phase	Yet to define the design task
Provide a basis for making	Using drawings as a resource during making	Clear development path through drawing into making	Object is one of the ideas drawn	Product relates to ideas recorded in the drawing	Making and object is seen as separate new activity
Comments to improve the learners performance in design capability:					

4.4 PROGRAMME OF ASSESSMENT

The programme of assessment is designed to organise the spread of formal assessment tasks in all subjects in a school per term throughout a year. Refer to page 40 for mark breakdown and to Annexure F (page 75).

4.4.1 Tests

- A standardised Test makes up 30% of each term's assessment.
- A test for formal assessment should cover a substantial amount of skills and content and should be set as follows: Grade 7: 45 minutes Grades 8 and 9: 60 minutes
- The mark for tests is not prescribed but should be determined by the teacher taking into account the volume of the content covered and the time available. Testing in Technology will be limited to ONE test each in terms 1, 2 and 3. This may take place either just before or just after the mini-PAT, and must be planned in the school assessment programme.

4.4.2 Mini-PAT

- The Mini-PAT makes up 70% of each term's assessment. Practical work must make up more than half of the marks.

4.4.3 Examinations

- All examinations must include questions that integrate **knowledge** and **values** with **design process skills.**
- In Technology the final end of year exam comprises 60% of the learners' promotion mark and should be set out as follows:

Grade	Time allocation	Mark weighting
7	60 minutes	60 marks
8	90 minutes	100 marks
9	120 minutes	120 marks

4.4.4 Content to be Assessed for the End-of-the-Year Examinations

- The content assessed at the end of the year is based on the year's work as specified in the CAPS document for the grade. However, prior knowledge from a previous grade may be necessary to interpret and answer some of the questions in the higher grade.

4.4.5 Type of Questions for Pen and Paper Test

- The value of memorising by rote learning has little weight in a subject requiring ***innovation***, ***creativity*** and ***problem-solving*** skills. The ability to ***think laterally*** and to develop ***original*** and ***appropriate solutions*** is a key element in learning Technology.
- Learners should be able to **investigate** using a variety of sources, demonstrate their ability to **draw** in a specific style, **write** a design brief, give specifications and constraints, **select** appropriate materials for a model, **plan** the sequence of manufacture of a product, **evaluate** a design objectively, **analyse** a system using systems diagrams and **communicate** their solutions using a range of techniques.

- Questions that integrate knowledge, skills and value have more value in technology than a mere recall of knowledge facts.

4.4.6 The Use of Case Studies

- Case studies are used to bring reality into the classroom.
- The intention should be to show learners that Technology is a subject that is close to the way the world works.
- Case studies can be used both to develop and to assess a technological skill (drawing for example), knowledge concepts, and values.

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 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. Seven levels of competence have been described for each subject listed for Grades R – 12. The various achievement levels and their corresponding percentage bands are as shown in the table below.

CODES AND PERCENTAGES FOR RECORDING AND REPORTING

RATING CODE	DESCRIPTION OF COMPETENCE	PERCENTAGE
7	Outstanding achievement	80 – 100
6	Meritorious achievement	70 – 79
5	Substantial achievement	60 – 69
4	Adequate achievement	50 – 59
3	Moderate achievement	40 – 49
2	Elementary achievement	30 – 39
1	Not achieved	0 – 29

Note 1: Assessment of learners may make use of fewer than seven level descriptors. Any assessment scale should have clear descriptors that give detailed information for each level. This means that a descriptor should say ***why*** an achievement is deemed to be 'outstanding' or 'elementary', etc. The descriptors on page 32 can act as a generic guide.

Note 2: Teachers will record actual marks against the task by using a record sheet; and report percentages against the subject on the learners' report cards.

4.6 MODERATION OF ASSESSMENT

Moderation refers to the process that ensures that 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. One purpose of moderation is to identify areas in which teachers may need development and support in their areas of work and provide the necessary support.

4.6.1 Formal Assessment (SBA)

Moderation of Assessment (Refer to Annexure H)

- All tasks in Grades 7 – 9 for formal assessment are internally set and moderated. The subject advisor must moderate a sample of these tasks during his/her school visits, to verify the standard of the internal moderation
- The subject head for Technology or head of department at the school will manage this process.
- A teacher must keep all formal assessment tasks, assessment instruments and record sheets on file.

4.6.2 Practical Assessment Tasks (Mini-PAT)

- Teachers will assess the mini-PATs in Grades 7 – 9.
- The subject head for Technology or head of department at the school must ensure that the practical nature of the subject is dealt with adequately, especially during the mini-PATs, and must plan for the acquisition of resources to enable this to happen.

4.7 ANNEXURES: SPECIFIC TO TECHNOLOGY PER PHASE.

Annexures: A, B, C, D, E, F, G and H are attached from page 48 to 78 of the document.

4.8 GENERAL

This document should be read in conjunction with:

4.8.1 National Protocol for Assessment for Grades R – 12

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

ANNEXURE A: TECHNOLOGY – PROGRESS MAP [SKILLS]

<table>
<tr><th colspan="3">INTERMEDIATE PHASE: PROCESS SKILLS</th></tr>
<tr><td colspan="3">In Grades 4 – 6 Technology is integrated with Natural Sciences
Science and Technology together should be able to build a learner’s investigative skills, especially the science discovery skills when doing practical experiments, and also research skills using reference books and other media. When analysing the results of experiments, junior Science and Technology learners will practise observing skills and critical thinking. During Science and Technology lessons the intermediate phase learner will draw simple diagrams showing a single viewpoint in two dimensions to represent experimental apparatus and design ideas for models that utilise the concepts being taught in Technology, e.g. a simple structure or a wheeled vehicle. In Science learners will draw conclusions from their experimental results and in Technology they will begin to evaluate designs in terms of fitness-for-purpose, aesthetic appearance and possible impacts on society and the environment.</td></tr>
<tr><td colspan="3">SENIOR PHASE: Process Skills</td></tr>
<tr><td rowspan="2">Design Process</td><td>Grade 7</td><td>Problems set in a locally relevant context.
Investigate: background context, nature of the need, environmental situation, people concerned.
Identifies technologies and methods. Considers source/resources and copyright laws. Uses search techniques. Extracts relevant data for specific purposes.
Design: people, purpose, appearance, environment, safety, cost of model.
Writes a design brief giving specifications and constraints (with assistance in terms 1 and 2). Generates at least two viable solutions using sketches with explanatory notes. Selects one solution giving reasons.
Make: develops plans for making detailing: resources, dimensions, making steps (such as simple flow diagrams). Draws simple plans using oblique technique. Chooses and uses appropriate tools and materials to make products by measuring/marking, cutting/separating, shaping/forming, joining/combining and finishing, with some accuracy. Uses safe working practices and uses correct tools for the job appropriately.
Evaluate: evaluates the product or system in terms of the design brief.
Evaluates the process followed and suggests improvements or modifications to the solution in terms of fitness for purpose.
Communicate: 3D sketches, plans using oblique projection, circuit diagrams with standard electrical component symbols, systems diagrams and simple flow charts. Plans include scale, thick, thin and dashed lines, dimensions and quantities. Artistic drawings in single VP perspective should be enhanced using colour, texture and shading.</td></tr>
<tr><td>Grade 8</td><td>Problems set in a nationally relevant context.
Investigate: background context, nature of the need, environmental situation, people concerned.
Identifies technologies and methods. Considers source/resources and copyright laws. Uses search techniques. Extracts relevant data. Makes meaningful summaries and uses the information to justify and support decisions and ideas.
Design: people, purpose, appearance, environment, safety, cost of real solution.
Writes a design brief giving specifications and constraints (without assistance). Generates several alternative solutions using sketches with explanatory notes. Selects the most suitable solution giving valid reasons.
Make: develops plans for making detailing: resources, dimensions, making steps (such as flow diagrams).
Draws simple assembly drawings (exploded diagrams) if needed. Draws plans using isometric projections. Chooses and uses appropriate tools and materials to make products by measuring/marking, cutting/separating, shaping/forming, joining/combining and finishing with accuracy. Changes and adapts design ideas where appropriate. Uses safe working practices and uses correct tools for the job appropriately.
Evaluate: evaluates the product or system objectively in terms of the design brief. Evaluates the process followed and suggests sensible improvements or modifications to the solution in terms of fitness for purpose.
Communicate: 3D sketches, plans using isometric projection, circuit diagrams with standard electrical component symbols, systems diagrams and simple flow charts. Plans include scale, thick, thin, dashed and chain lines, dimensions and quantities. Artistic drawings in double VP perspective should be enhanced using colour, texture, shading and shadows.</td></tr>
</table>

<table>
<tr>
<td>Design Process</td>
<td>Grade 9</td>
<td>Learners must identify a problem, need or opportunity from a given real-life context.

Investigate: background context, nature of the need, environmental situation, people concerned.

Locates and collects. Compares, sorts, verifies, evaluates (cross-checking different sources or resources) and stores information.

Design: people, purpose, appearance, environment, safety, real costs, ergonomics, quality, production.

Writes a design brief giving specifications and constraints (without assistance). Generates a range of possible solutions using sketches with explanatory notes. Selects the most viable solution using well-reasoned argument.

Make: develops plans for making detailing: resources, dimensions, making steps (such as flow diagrams). Draws simple assembly drawings (exploded diagrams) if needed. Draws working drawings using first angle orthographic projections. Chooses and uses appropriate tools and materials to make products by measuring/marking, cutting/separating, shaping/forming, joining/combining and finishing with accuracy. Changes and adapts design ideas where appropriate. Uses safe working practices and uses correct tools for the job appropriately.

Evaluate: evaluates the product or system in terms of the design brief. Evaluates the process followed and suggests sensible improvements or modifications to the solution in terms of fitness for purpose.

Communicate: 3D and 2D sketches, plans using first angle orthographic projection, circuit diagrams with standard electrical and electronic component symbols, systems diagrams and simple flow charts. Plans include scale, thick, thin, dashed and chain lines, dimensions and quantities. Artistic drawings in either single or double VP perspective should be enhanced using colour, texture, shading and shadows.</td>
</tr>
<tr>
<td colspan="3">FET Process Skills – Grade 10</td>
</tr>
<tr>
<td colspan="3">The Grade 9 learner promoted to FET will benefit from a range of skills that are developed further in the FET band, particularly in the technical subjects. These skills will assist the FET learner to different extents depending on the direction chosen in FET.

In GET Technology learners practise using the design process and this will aid them in related FET subjects. GET learners are introduced to drawing, both for planning purposes and for artistic purposes.</td>
</tr>
</table>

TECHNOLOGY – PROGRESS MAP [GRAPHICS]

SENIOR PHASE: DRAWING SKILLS		
Technology Drawing Sketches and Working Drawings	Grade 7	Free-hand sketching. 2D view of one face drawn to scale with correct line types and dimensions. 3D oblique technique: 45° cabinet projection to scale with correct line types and dimensions. Line types: outlines, construction lines, hidden detail.
	Grade 8	Free-hand sketching. 2D view of one face drawn to scale with correct line types and dimensions according to conventions. 3D isometric projection 30°: drawn using underlying grid to scale with correct line types and dimensions. Line types: outlines, construction lines, hidden detail lines, centre lines, wavy lines.
	Grade 9	Free-hand sketching. 2D working drawings in first angle orthographic projection: elementary use of instruments. 3D isometric projection: 30° drawn using underlying grid to scale, correct line types and dimensions. Line types: outlines, construction lines, hidden detail lines, centre lines, wavy lines. Dimensioning: conventions, arrows. Drawing boards NOT required.
Artistic Drawing Sketches and Presentation Graphics	Grade 7	Single vanishing point perspective; texture rendering; colour.
	Grade 8	Double vanishing point perspective; texture rendering; colour; shading.
	Grade 9	Single and double vanishing point perspective; texture rendering; shading; colour; shadows. The Grade 9 learner should demonstrate progress in skill levels relative to previous grades.

DESIGN

Usually a designer will visualise an object in three dimensions but will then draw the initial working drawing in two dimensions.

For example, when designing a house, the architectural designer will have an idea of the overall look – whether it is large or small, double- or single-storey and what colour the roof tiles are. However, when drawing the design of the house, the designer will invariably draw a two-dimensional birds-eye “plan-view” of the house seen from above without the roof on. This view allows the designer to decide on number of rooms, positions of bathroom relative to bedrooms and kitchen relative to dining area. Once the top or “plan” view has been completed, the designer then draws two-dimensional views of the key sides of the house – termed “elevations”. There will be a “front elevation” showing the house as seen from the front, and at least one other side, perhaps the “east elevation”. The number of views will depend on the complexity of the design. An RDP house needs no more than two elevations, while a complex mansion will need at least four elevations.

When all working drawings are completed, the designer will draw an “artist’s impression” using 3D double vanishing point perspective. Colour and shading will be added to enhance the drawing and texture rendering will be used to provide realism – wooden doors will be rendered to look like wood and roof tiles will be rendered to look like slate or cement. These artistic drawings are important because few house-buying clients can visualise the final appearance of the new house they are having built when they look at two-dimensional working drawings. Further artistic drawings may be drawn to show specific rooms, like the kitchen fitted out with cupboards and work surfaces, or the bedroom showing the bed, carpet and cupboard space. Again colour and texture will be used to assist the buyers to get a feel for their new home. Usually individual rooms will be drawn using single vanishing point perspective.

When designing a simple 3D object, like a milk jug, the industrial designer is likely to visualise the jug AND draw it using 3D isometric view. Additional simple 2D drawings may be done to show the top and side views in order to give clear dimensions.

Sketches are the most effective way of communicating design ideas. This is especially true in our multi-lingual society. The language of graphics transcends spoken language and is generally unambiguous once the learners become familiar with the drawing conventions.

NB: It is important to understand that the **suitability of the design (fitness-for-purpose)** is more important that the **draughting skills** at this stage. A badly designed house (perhaps lacking a kitchen) is of little value no matter how neatly and accurately it is drawn.

TECHNOLOGY – PROGRESS MAP [KNOWLEDGE]

Due to the fact that knowledge in Technology is interlinked and interdependent, note that tasks are usually ***INTEGRATED***. Although a knowledge focus may be the primary target of a particular task, it is natural for aspects of more than one knowledge focus to appear in the same term.

Topic		Senior Phase: Content
Structures	Grade 7 Terms 2 – 3	Purpose of structures: contain, protect, support, span. Natural and man-made structures. Types of structures: shell, frame, solid. Strengthening structures by folding, tubing and triangulation. Frame structures: roof trusses, towers. **Task**: cell phone tower (link: electronic communications). Frame structures: cranes.
	Grade 8 Term 1	Reinforcing: struts, ties. Stabilising: base size, base angles, centre of gravity, ground anchors. Strengthening structures using folding, tubing, triangular webs and internal cross-bracing. Pylons (link: electrical systems, the national grid). Components of frame structures: arch, beam, cantilever, column. **Task**: frame structure using mechanisms.
	Grade 9 Term 1	Strength of materials under the action of forces: compression, tension, torsion, and shear. Properties of construction materials: mass, density, hardness, stiffness, flexibility, corrosion. Suitability of materials (fitness-for-purpose) in terms of properties, safety and cost effectiveness. **Task**: identify and solve problems related to community on the far side of a river.
Mechanical Systems and Control	Grade 7 Terms 1 3 – 4	Simple mechanisms; first-, second- and third-class levers. • Mechanical advantage/disadvantage using levers (*elementary qualitative treatment*). • Levers and linkages. • Pneumatics and hydraulics used to increase human strength. **Task**: hydraulic powered rescue equipment. More simple mechanisms – wheel and axle, cranks and pulleys, gears. More simple mechanisms – wedge, gear ratios, cams. • Mechanical systems that change the magnitude of forces involved: gear ratios. • Mechanical systems that change the rotary to linear motion: crank, cam.
	Grade 8 Term 3	Simple mechanisms as components of more complex machines designed to provide users with a mechanical advantage: • Linked lever systems. • Gears (link to term 1: spur, bevel, rack and pinion, worm). • Gears – driver, idler, driven; velocity ratio/force multiplication. • Belt drive and chain drive systems – chain block, bicycle or motor cycle gear cogs. • Hydraulic/pneumatic systems. • Mechanical advantage – including simple calculations. • Systems diagrams. **Task**: mine shaft headgear.

Mechanical Systems and Control	Grade 9 Term 2	Interacting mechanical systems and sub-systems. • Hydraulic principles: incompressibility of liquids, pressure in liquids, force transfer. • Hydraulic/pneumatic systems that use restrictors, one-way valves: hydraulic press/jack. • Gear systems – spur, bevel, rack and pinion, worm. • Mechanical control mechanisms – ratchet and pawl; cleats; bicycle brakes; disc brakes. • Belt-drive systems with more than one stage. • Pulley systems – fixed pulley, moveable pulley, and multiple pulleys (block and tackle). • Systems where mechanical, electrical or pneumatic systems are combined. **Task**: identify and solve problems that can be solved by mechanical systems integrated with either electrical/ electronic or hydraulic or pneumatic.

TECHNOLOGY - PROGRESS MAP [KNOWLEDGE]

TOPIC		GET: CONTENT
Electrical Systems and Control (Grade 9 Electronic)	Grade 7 Term 3	Electrical circuit basics: • Basic circuit components: cell(s), conductor, switch, resistor, lamp. • Simple circuit diagrams showing various component arrangements. Magnetism and magnetic metals: iron and steel, nickel, cobalt. • Introduction to electromagnetism: the electromagnet. • Recycling metals. **Task**: design and make a crane to carry an electromagnet to sort scrap metals for recycling.
	Grade 8 Term 4	Electrical circuit basics: • Circuit diagrams, conventions and component symbols. • Input devices, control devices, output devices. • Circuit design (simple) and circuit interpretation. • Circuits with more than one input or control device. Electrical energy sources (including illegal connections): • Sources of direct current: electrochemical cells; photovoltaic cells. • Sources of alternating current: generating (thermal and alternate). • Distributing a.c electricity: the national grid, transformers (an application of electromagnetism). Ohm's Law: *qualitative* treatment. Logic conditions: • **AND** logic (series); truth table. • **OR** logic (parallel); truth table. **Task**: dual switch system like an alarm circuit with at least two panic buttons in different rooms, or similar concept using either AND or OR logic conditions.
	Grade 9 Term 3	Electronic systems and control – how simple electronic circuits and devices are used to make an output respond to an input. Learners should be able to read a ***given*** electronic circuit diagram and assemble the components into a working circuit. • Input components: electrochemical cells, photovoltaic cells. • Storage components: electrochemical cells, capacitors. • Control components: switches, resistors, diodes, light emitting diodes (LED), transistors. • Sensor components: thermistors, light dependent resistors (LDR). • Output components: lamp, buzzer/bell, light emitting diodes (LED). • Resistor codes. • Ohm's Law: *quantitative* treatment with graphs and calculations. **Task**: identify a problem that can be solved by an electronic circuit. Assemble a given electronic circuit and design a device which can utilise the circuit to solve the problem.

TECHNOLOGY – PROGRESS MAP [KNOWLEDGE](cont.)		
Processing	Grade 7 Terms 3 – 4	Recycling scrap metals – sorting ferrous and non-ferrous metals. Improving properties of materials. • Improving the properties of wood: waterproofing. • Improving the properties of textiles: waterproofing, fire-resistance. **Task**: emergency shelter for refugees.
	Grade 8 Term 2	Positive and negative impacts of technological products on the environment and/or society. Improving properties of materials to adapt them to suit particular purposes: • Withstand forces – tension/compression/bending/torsion/shear • Recycling: paper. • Adapt material for packaging of a product. **Task**: design a product that will solve or reduce the negative impact of the technology studied earlier.
	Grade 9 Term 4	Extending lifespan: • Metal – paint, galvanise, and electroplate**: Practical** – preserving metal by electroplating. • Food – freeze, pickle, dry, salt: **Practical** – preserving food by drying/salting. Types of plastics and their uses. Recycling plastics to provide raw material for manufacture of new plastic products. **Task**: identify a problem in a given scenario where cutting, joining, bending or moulding plastics can be used to make a product that will satisfy a need, want or opportunity.
NB: Technology, society and the environment must be addressed throughout the syllabus wherever applicable. The activities prescribed provide ample opportunities for dealing with indigenous technologies, the impact of technology, and bias in technology.		

ANNEXURE B: TOOLS FOR TECHNOLOGY

Sophisticated high-tech equipment is not needed to reach the aims of the Technology subject.

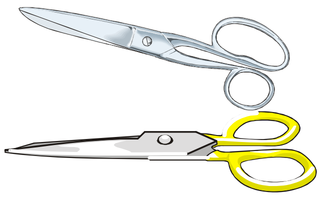
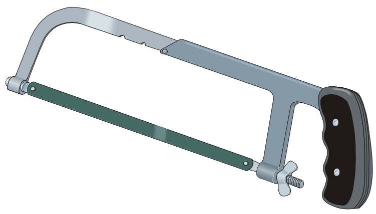
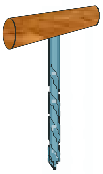
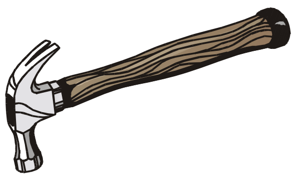
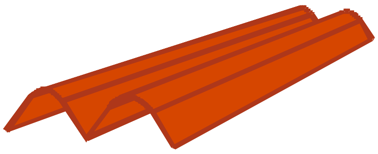
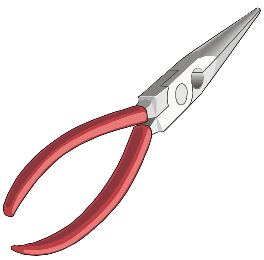
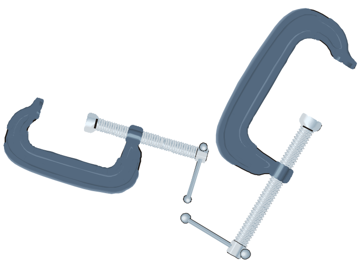
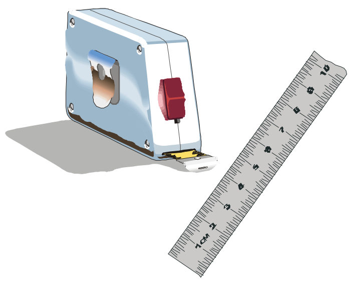
Simple tools and cheap materials are all that will be required for this syllabus.

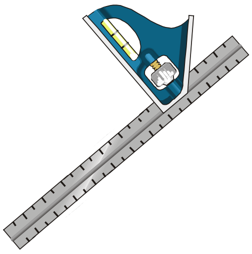
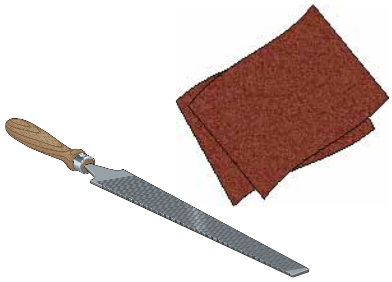
Learners should be encouraged to manage with minimal supply levels as this develops ***problem solving, lateral thinking and creativity***.

In GET, learners will require mainly scissors, craft knife, rulers, pliers, hammer, hand drill, junior hacksaw, coping saw and simple materials like sticky tape, cardboard, foam plastic and found materials.

Here is an illustrated list of the tools you may want to acquire for your technology centre over a period of time.

Start with those illustrated on this page first.

Scissors	**Craft Knife (with retractable Blade)**	**Junior Hacksaw**
		
Bradawl	**Hammer**	**Safety Ruler**
		
Long Nose Pliers	**G-Clamp**	**Tape Measure or Ruler**
		

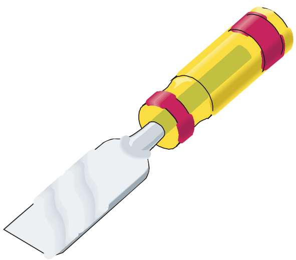
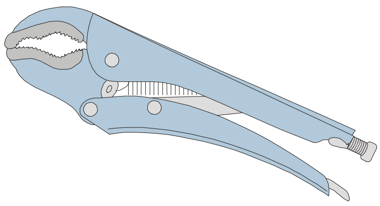
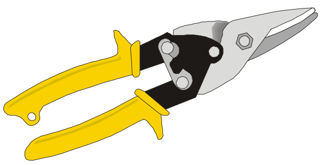
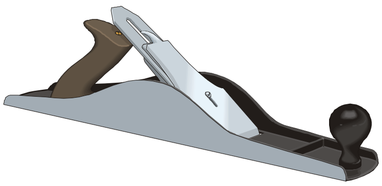
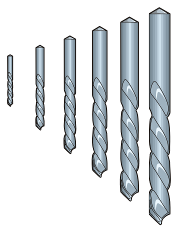
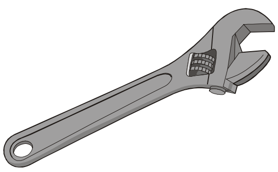
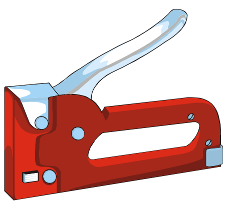
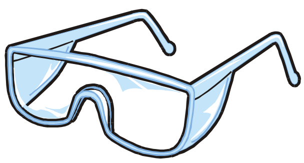
Combination Square	Screw Drivers	File or Sandpaper
		

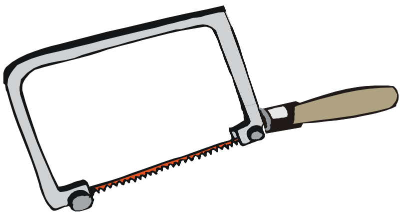
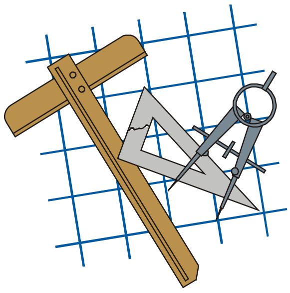
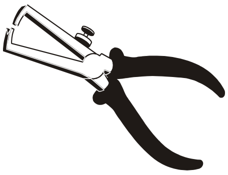
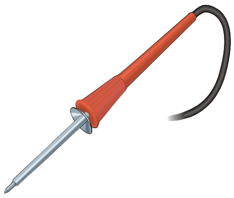
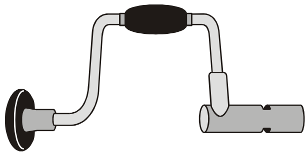
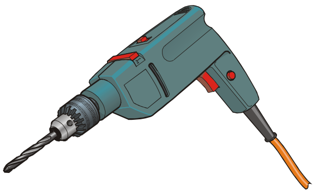
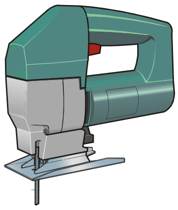
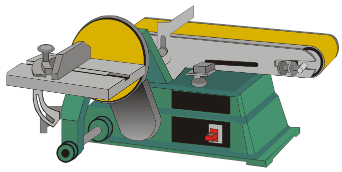
Electric Systems: insulated electrical wire, torch cells, torch bulbs, crocodile clips, switches (push, SPST, SPDT, and DPDT), resistors, rheostat (variable resistors), voltmeter, and ammeter.

Electronic Systems: Diode, LEDs (various colours), Light Dependent Resistor, Thermistor, Touch or Moisture Sensor, npn Transistor, Capacitor (polarised & unpolarised), Buzzer/Bell, 470 ohm Resistor,

Solder, Soldering Iron, Desoldering pump.

Precise descriptions will be given by the textbooks according to the tasks planned by different authors.

Electric Glue Gun	Chisel	Vice grip
		
Tin Snips [Metal Shears]	**Hand Plane**	**Drill Bits**
		
Adjustable Wrench	**Staple Gun**	**Safety Goggles**
		

Coping Saw 	**Drawing Aids** 	**Hand drill** 
Wire Stripper 	**Soldering Iron** 	**Hand Brace** 
THE FOLLOWING POWER TOOLS ARE NOT REQUIRED, BUT ARE “NICE TO HAVE”		
Electric Drill 	**Electric Jig Saw** 	**Disc / Belt Sander** 

The following pages give details of tools and materials that could by found in very well-equipped technology centres. Many of them will not be used by untrained teachers and should NOT be bought unless the task warrants it. Schools are encouraged to develop the subject to levels that have **high expectations** of their learners.

However, do not budget for items that cannot be justified by the curriculum being delivered.

TOOLS FOR DIFFERENT APPLICATIONS IN TECHNOLOGY

Solving problems in real-life situations requires using a wide range of materials and many tools to process them. Here follows a list of possible applications and the tools needed to work on them. Specific requirements depend on the tasks set.

ADHESIVES

TYPE	PURPOSES	PROPERTIES	SETTING TIMES	BRAND NAMES	SOLVENTS
Clear cellulose adhesive	Wood, cork, leather, PVC	Waterproof, heat resistant, flammable	10 – 20 minutes	Bostik, Pattex, etc.	Thinners, acetone
Contact adhesives	Wood, hardboard plastic, metal	Heat resistant, waterproof, flammable	5 minutes	Pattex, Alcolin, etc.	Thinners
Cyanoacrylic “Superglue”	Plastic, glass, ceramics	Fairly strong but brittle, fails due to vibrations	Instant	Bostik, etc.	Acetone
Epoxy resins	Wood, metal, glass, plastic	Very strong, heat resist, waterproof	20 minutes to 24 hours	Pratley Putty, etc.	None once set
PVA	Wood, paper, card, hardboard	Strong but not heatproof nor waterproof	20 – 60 minutes	Alcolin, Pattex, Ponal, etc.	Water – before fully dry.
Homemade flour paste	Gluing paper, papier-mâché	Cheap, suitable for purpose	30 – 60 minutes	-	Water

WORKING WITH PAPER AND CARD

Pencils:	H and HB grades are the most useful.
Crayons:	Wax and pencil crayons – choose according to need.
Felt-tipped pens:	Felt or nylon tips give clear permanent colours.
Felt-tipped markers:	Large bullet or chisel pointed markers, with a limited colour range.
Erasers:	Medium grade advised.
Paints:	*Water based* – range from watercolours, poster paints, and acrylics. *Enamel* – have a varnish base giving hard, glossy finish. *Cellulose* – aerosol cans are available in most hardware stores. *Primers and undercoats* – most bare surfaces need priming before applying the top coat. *Varnishes* – these give a clear protective coating to paintwork. Spirit-based varnishes dry quickly. Polyurethane varnishes give a tougher finishes, but dry slowly.
Brushes:	Brushes made from man-made fibres are cheaper and adequate for school purposes. Small, pointed brushes are needed for fine detail; broader brushes are used for larger surfaces. All brushes should be cleaned immediately after use using the same thinning medium as used for the paint.
Stencils and transfers:	Used for lettering or applying pre-designed patterns.
Craft knives:	A range of knives is available, from carpet knives to scalpels. For safety, choose a size to suit the level of the learners, and be sure that the blade is retractable for safety reasons.
Safety rulers:	These steel rules provide protection for fingers when cutting sheets of paper, cardboard or carpet using a craft knife.

Rulers:	For measurement only – flat steel rules and plastic rulers may not be used to guide a craft knife when cutting.
Finding angles:	Use setsquares or a protractor to mark out angles.
Drawing circles:	Use drawing compasses or use a circular shape as a stencil.
Staplers:	Common office staplers for paper. Staple guns for fixing paper or cloth to wood frames.

WORKING WITH METAL

Metalwork is likely to be limited to small items – so there will be no need of bending machines and guillotines. Learners are likely to work with wire, small metal rods for axles, flat bar, round bar, square bar, and lightweight metal sections, like angle iron. Metals used could include iron, tin, copper and aluminium.

Cutting:	Junior hacksaw – preferably the type with vertical handle. Hacksaw. Metal snips/shears. Side cutters – 160mm.
Holding:	Engineer's Vice – 100mm jaws, fixed to bench. Vice grips – 280mm. G-clamps – 100mm and 250mm jaws suit most jobs. Combination pliers – 160mm. Needle nose pliers – 160mm (for wirework).
Marking:	Scriber. Compasses/dividers.
Guiding:	Try square – preferably with 45° mitre. Combination square – measures 90°, 45° and depth. Sliding "T" bevel – can be set at any angle.
Drilling:	Hand drill [wheel brace] – for drilling holes up to 4mm in diameter. Power drill – 350 – 500W will be adequate – holes from 1 – 12mm diameter. Twist drills – set 1 – 12mm – use only HSS grade for metals.
Joining:	Metals can be joined in a variety of ways: Shifting spanner – 250mm. Bolting – a range of machine screws are available in brass or iron. *Suitable sizes depend on purpose: 15mm to 40mm are most common.* Riveting – using pop riveter and pop rivets, or hammered rivets. Gluing – modern epoxy resins can bond metals very effectively. Soldering – either using electric soldering iron or a gas flame. *Soldering iron stands; desoldering pump*

WORKING WITH WOOD

Holding:	Carpenter's vice. Bench hook. G-clamps – 100mm and 250mm jaws suit most jobs. Sash clamps – 500mm and 1 200mm.
Marking tools:	Carpenters pencil. Scriber. Compasses/dividers.
Guiding tools:	Try square – preferably with 45° mitre. Combination square – measures 90°, 45° and depth. Sliding "T" bevel – can be set at any angle. Mitre box – a guide for the tenon saw when cutting 45° and 30° mitres. Spirit level.
Measuring tools:	Steel tape – 3m retractable. Steel rule – 300mm or 500mm.
Cutting tools:	A tenon saw – the type with a ridged back is indispensable for many tasks. A fretsaw – cuts curves and irregular shapes in **thin** wood – need spare blades. A coping saw – similar to a fretsaw, but can be used to cut thicker wood. Chisel set: range – 6mm, 10mm, 15 – 20mm.
Smoothing:	Smoothing plane – steel with adjustable blade, about 44mm wide. Surform – easy-to-use tool with fixed-blade plane made by Stanley Tools. Wood rasp – 250mm half-round: For rough shaping – flat and concave curves. Flat file – 150mm fine cut – useful for model making. Glass-paper – coarse to fine grades.
Drilling:	Bradawl – for starting small screws and marking pilot holes before drilling. Hand drill [wheel brace] – for drilling holes up to 6mm diameter. Brace and bits – cut larger holes than the wheel brace 6 – 30mm. Twist drills – set 1 – 12 mm – note wood drills are not suitable for metals. Countersink – to allow screw heads to lie flush with the surface.
Screwing:	Screw drivers – flat 3mm, flat 5mm, star (or cross head). Wood screws – steel and brass – sizes according to needs – 15mm to 50mm. Chipboard screws – steel – 15mm to 40mm.
Nailing:	Claw hammer [350g] - claw is for pulling out nails. Ball-peen hammer [300g]. Cross-peen hammer [200g] – useful light-weight hammer. Pin punch – for sinking panel pinheads below the surface. Panel pins – sizes: 12mm, 19mm. Nails – sizes: 12mm, 19mm, 25mm, 40mm.

WORKING WITH ACRYLICS AND OTHER PLASTICS

Acrylic plastics (e.g. Perspex) form a versatile group of materials for making plastic items. It can be clear or coloured and can be sawn, drilled and filed into shapes easily. It is supplied in transparent or opaque sheets, rods or tubes in wide variety of colours.

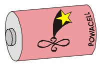
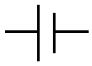
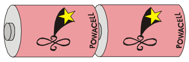
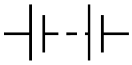
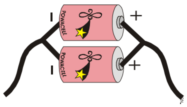
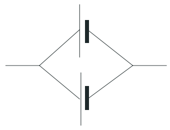
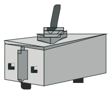
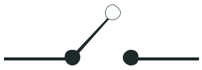
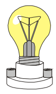
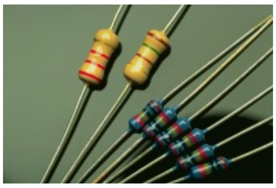
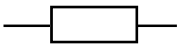
Oven gloves:	For handling Perspex heated for bending.
Cutting & shaping:	Craft knife, coping saw, fret saw, hacksaw. Files [*flat, half round, needle*].
Marking:	Ruler, scriber, setsquares, protractor, stencils, compass.
Drilling:	Hand drill, set of twist drills.
Bending:	Requires temperatures from 150º – 180º Celsius.
Holding:	G-clamps, bench vice, masking tape, double-sided tape.
Joining:	Acrylic cement [glue], silver or copper wire [for riveting].
Finishing:	Wet-or-dry abrasive paper in a range of grades: *– 240 coarse, 320 medium, 600 fine; and metal polish [e.g. Brasso].*

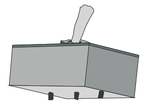
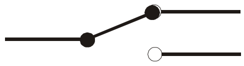
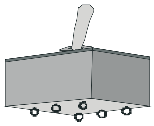
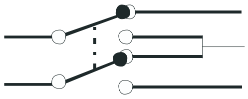
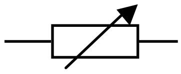
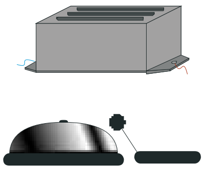
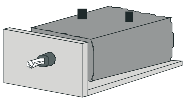
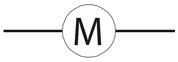
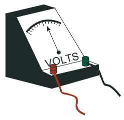
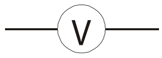
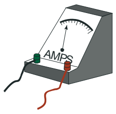
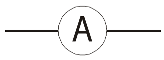
CAUTION: All acrylic glues and resins are highly inflammable and should be kept away from naked flames. The fumes can be irritating and well-ventilated space should be used. Avoid skin contact by using rubber gloves. Wash with soap and water after accidental contact.

Electrically Powered Tools:

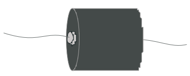
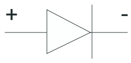
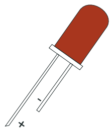
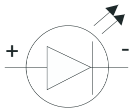
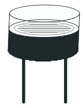
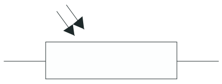
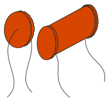
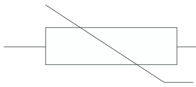
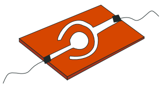
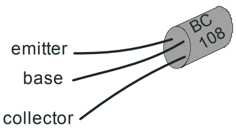
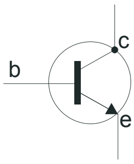
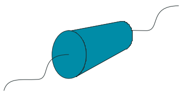
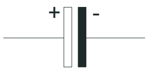
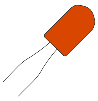
Electric drill:	450 – 600W with percussion.
Jig saw:	Must have orbital action option and ability to plunge through undrilled surface.
Belt sander:	80mm – avoid industrial strength equipment needing high skill and strength.
Orbital sander:	1/3-sheet machines are adequate.
Soldering Irons:	Low power for electronics.
Scroll saw:	Table model – used for wood and acrylics (more useful and safer than band saw)
Disc/belt sander	Table model – 80mm wide belt, 150mm disc.
Bench grinder:	Table model – one grinding wheel, one buffing wheel for acrylic work.
Hot plate:	Two plate model.
Line bender:	For bending acrylic plastics (*very simple candle-heated models exist*)
Vacuum former:	For vacuum-forming using ABS plastic sheets.

ANNEXURE C: ELECTRICAL AND ELECTRONIC COMPONENT SYMBOLS

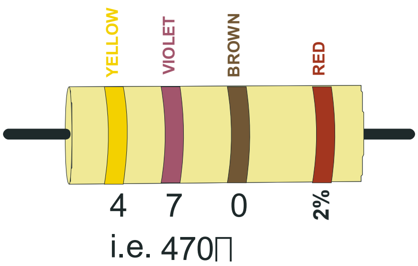
Electrical Component Symbols: Grades 7, 8 and 9			
Name	**Picture**	**Symbol**	**Use**
Electrochemical cell			Input device: source of Energy
Series battery			Input device: source of more Energy
Parallel battery			Input device: source of Energy for longer
Push switch			Control Device: Used to temporarily close a circuit – like ringing a door bell
SPST switch *Single Pole Single Throw*			Control device: opens or closes a circuit
Lamp/light bulb			Output device: lights up when current heats it up.
Resistor			Process device that restricts the flow of an electric current

Electrical Component Symbols: Grades 8 and 9			
SPDT switch *Single Pole Double Throw*			Control device: diverts current down either one of two possible paths [an OR logic gate]
DPDT switch *Double Pole Double Throw*			Control device: diverts current down either one of two possible paths [an OR logic gate]
Variable resistor (rheostat)	Stove plate switch: high/low Light dimmer switch Volume knob on FM radio Heat setting on a steam iron		Adjustable process device: restricts the electric current, e.g. stove switch
Bell and Buzzer			Output device: vibrates to give off sound when current passes through it – useful as an alarm
Motor			Output device: motor turns converting electric energy into kinetic energy
Voltmeter (*Connect in PARALLEL*)			Output device: meter responds to potential difference
Ammeter (*Connect in SERIES*)			Output device: meter responds to current

Electronic Component Symbols: Grade 9

Name	Picture	Symbol	Use
Diode			Control device: allows current to flow in one direction only
LED (Light Emitting Diode)			Control device: allows current to flow in one direction only, and emits light
LDR (Light Dependent Resistor)			Sensor: detects light; resistance decreases in bright light
Thermistor +t OR -t			Sensor: detects heat: +t: Hotter = more resistance -t: Hotter = less resistance
Touch or Moisture detector			Sensor: detects moisture
Transistor npn			Control device: can act as a switch or an amplifier
Capacitor *Polarised*			Control device: can store and release energy (must be connected + to +)
Capacitor *Unpolarised*			Control device: can store and release energy

RESISTOR COLOUR CODES



The first three bands give the value of the resistor in ohms [Ω].

The fourth band is an accuracy rating **%**.

Most expensive and most accurate = RED.

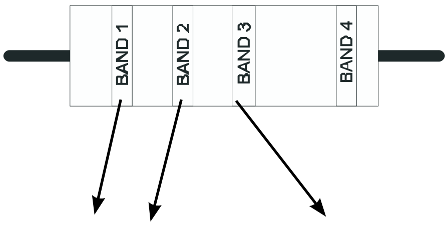
Medium expensive and accurate = GOLD.

Least expensive and accurate = SILVER.

RED – the resistor is within 2% of the coded accuracy value.

GOLD – the resistor is within 5%.

SILVER – the resistor is within 10%.



COLOUR	1	2	ZEROS								
BLACK	0	0									
BROWN	1	1	**0**								
RED	2	2	0	0							
ORANGE	3	3	0	0	0						
YELLOW	**4**	4	0	0	0	0					
GREEN	5	5	0	0	0	0	0				
BLUE	6	6	0	0	0	0	0	0			
VIOLET	7	**7**	0	0	0	0	0	0	0		
GREY	8	8	0	0	0	0	0	0	0	0	
WHITE	9	9	0	0	0	0	0	0	0	0	0

ANNEXURE D: TECHNOLOGY SUBJECT GLOSSARY

This is an alphabetical list of some key terms used in the Technology subject

Aesthetics

Characteristics of a product or system that makes it look beautiful and attractive.

Analyse

Look carefully at a problem or need in order to explain its causes and effects, or carefully look at information to determine its validity and importance, or examine an item (e.g. a structure) and see how it functions and what it consists of.

Artefact

A manufactured object.

Anthropometrics (linked to ergonomics)

Measurements of people's shapes and sizes. Such measurements are usually taken when products are designed for human use, e.g. furniture, eating utensils, hairdryers, sporting equipment cars, clothing, etc.

Biases

People's preconceived ideas or prejudices about some things or people before they actually meet or deal with them. These are normally in areas of human rights and inclusitivity such as gender, race, ethics, religion, etc. For example most cameras are biased towards right-handed people, very few women enter the mechanical engineering industry in South Africa, etc.

Biophysical environment

The land, air and water around us; it is also the space in which we find ourselves.

Classify

Arrange in groups according to similar features or qualities.

Compare

Describe the similarities and/or differences between two products, or items, or solutions or situations.

Compression

A squeezing force.

Constraints

Aspects that limit conditions within which the work or solution must be developed, e.g. time, materials, tools, human resource, cost, etc.

Control

The means by which systems are regulated, i.e. an adjustment of the process, which makes the actual result conform more closely to the desired result.

Conventions

Ways of showing information on designs or working drawings that are understood and recognised to have specific meaning.

Craft

The repetitive production of artefacts, usually for sale. It requires skill in planning the production and making of items and needs manual dexterity and artistic skill. Craft occupations include carpentry, sewing and pottery. It typically involves repetition where many items, often using existing patterns or plans, are manufactured during a production run. Although there is common ground, craft should not be confused with Technology, nor with Art.

Criteria

Statements of a particular standard or requirement that a solution must satisfy.

Data

Raw facts and figures (statistics, rainfall figures, temperature readings, etc.). Data may be processed into information.

Demonstrate

Show key features of an item or product.

Describe

Tell in words listing features and/or functions

Discuss

Write or speak about a topic or event or item or problem in order to get feedback / opinions from others.

Design (noun)

The plan, sketch, model, drawing, etc. that outlines or shows the intention of the proposed solution.

Design brief

A short and clear statement that gives the general outline of the problem to be solved as well as the purpose of the proposed solutions.

Design process

A creative and interactive approach used to develop solutions to identified problems or human needs.

The associated skills are investigating, designing (development of initial ideas), making, evaluating and communicating.

The design process is utilised by engineers, architects, industrial designers, and many others when developing original ideas to meet needs or wants, and to solve problems.

The design process skills explained:

- **Investigate**

Investigating a situation to gain information is an important starting point for Technology. Research or finding of information mainly takes place here. Learners gather data and information, grasp concepts and gain insight, find out about new techniques, etc. Some skills needed for investigating are information accessing and processing skills, recording, identifying, predicting, comparing, observing, classifying, interpreting, collating, etc.

- **Design** (verb)

Once a problem is fully understood, the design brief needs to be written. Possible solutions should then be generated. These ideas may be drawn on paper. The first idea may not necessarily be the best; so several different solutions are desirable. This part of the design process requires awareness and the knowledge and skills associated with graphics, such as the use of colour, rendering techniques, 2D and 3D drawings, etc. These in essence include abilities in planning, sketching, drawing, calculating, modelling, and managing resources. Once possible solutions are available, a decision must be made. The chosen solution will be the one that best satisfies the specifications. It is expected that learners justify choices made. At this point final drawings/sketches (working drawings) of the chosen solution should be prepared. They should contain all the details needed for making the product or system. These include instructions, dimensions, annotated notes, etc. Testing, simulating or modelling the solutions before final manufacture is done here.

2D – two-dimensional – a flat drawing, in which only two principle dimensions (measurements) are visible (e.g. length and height).

3D- three-dimensional – a pictorial drawing. A drawing in which the three principle dimensions are visible, also the three principle faces are visible in the one drawing.

- **Make (verb)**

This aspect provides opportunities for learners to use tools, equipment and materials to develop a solution to the identified problem, need or opportunity. It involves building, testing and modifying the product or system to satisfy the specifications of the solution (design specification). Learners will cut, join, shape, finish, form, combine, assemble, measure, mark, separate, mix, etc. Making should be according to the design, although modifications are also desirable. Making must always be undertaken in a safe and healthy atmosphere and manner.

- **Evaluate**

Learners need to evaluate their actions, decisions and results through the Design Process. Learners need to evaluate the solutions and the process followed to arrive at the solutions. They should be able to suggest changes or improvements where necessary. Some evaluation should be done against criteria (e.g. constraints) that may be given or self-generated. This stage requires the use of probing questions, fair test, analysis, etc.

- **Communicate**

In this aspect the assessment evidence of the processes follow any given project, i.e. the ability to analyse, investigate, plan, design, draw, evaluate and communicate. This could be done in various modes like oral, written, graphic or electronic presentation. A record of the processes from conception to realisation of the solution (i.e. investigating to communicating solutions) should be kept in the form of a project portfolio.

Enabling tasks

Activities used to teach and then practice specific skills in preparation for a more advanced task – sometimes also called resource tasks.

Ergonomics

Features of a product or system that makes it user-friendly.

Explain

Make clear by giving more information.

Findings

Things that have been discovered after a process of investigation or research.

Fitness-for-purpose

A solution should be evaluated in terms of the design brief, specifications and constraints AND whether it will meet the purpose for which it was designed.

Force

Sometimes described as a push or a pull. However, in Physics, the force may be ***in contact*** or it may ***act across a space*** (e.g. gravity, magnetism). The scientist is specifically concerned with the effect of a force on the motion of a body, viz. unbalanced forces cause acceleration, 'deceleration' or direction change. In Technology, designers are concerned only with ***contact forces*** (e.g. a load), and is specifically concerned with the effect the force has on the integrity of a structure, viz. will it bend, stretch, twist or will joints break leading to structural failure?

Forming

Changing a material's shape without cutting it.

Identify

Establish who/what something is e.g. identify a type of structure.

Illustrate

Explain or make something clear by using examples or words or diagrams.

Input

The command/information entered into a system.

Information

Data that has been processed (recorded, classified, calculated, stored, etc.). Knowledge is gained when different kinds of information are compared and conclusions are drawn.

Isometric

A 3D drawing where the lines of sight are set at 30 degrees.

Machine

A device made up of a combination of simple mechanisms linked so as to form a system for the purpose of doing work.

It can be designed to increase the mechanical advantage and decrease the velocity ratio OR to increase the velocity ratio while decreasing the mechanical advantage.

Materials

Physical substances used in technology, e.g. wood, textiles, fabric, plastic, food, etc.

Mechanical advantage

A concept that describes how much easier mechanisms or machines can make a particular task. The amount of work done is the same, and the amount of energy expended is the same, but the effort used (force) is less because it is applied over a greater distance, and for a longer period of time.

Mechanism

Parts that can turn one kind of force into another and give mechanical advantage or a distance advantage. Mechanisms can be combined to form a machine. The basic mechanisms are the lever and the wedge/inclined plane. Cams/cranks and pulleys/gears are adaptations of the wheel and axle – which is itself a special case of the first class lever.

Mini-PAT

A short Practical Assessment Task which makes up the main formal assessment of a learner's skills and knowledge application during each term. It may be an assignment covering aspects of the design process, or it may be a full capability task covering all aspects of the design process (IDMEC).

Mode

A way or manner in which a thing is done.

Modelling

The testing of a solution, (product or system). This could include using small replicas (scale models), and intangible representations of the solution (mathematical models, computer models, etc.).

Need

A necessity for basic function, e.g. food is a need.

Oblique

A 3D drawing where the depth of an object is projected at a 45 degree angle to the 2D front view.

Opportunity

The chance to do something about a need or a want.

Orthographic

A type of 2D drawing. It usually shows three separate views of the same object (e.g. front, top and left views). The technique is used to draw formal working drawings.

Output

The actual result obtained from a system.

Perspective

A 3D artistic drawing in which the lines of sight converge to vanishing points on the horizon. It can be drawn either to a single vanishing point or to double vanishing points (at this level).

Product

The physical/tangible artefact that results from the process (model, poster, chart, etc.).

Preserving

A process that prolongs the natural life of a product.

Process

The part of a system that combines resources to produce an output that is in response to input.

Problem

Something that leads to a need or want and that can give rise to an opportunity.

Pulley

A wheel with a groove on its circumference. It is used to transmit movement and is used with a belt or a rope.

Recycle

To reuse all or part of a substance, including breaking it down to raw material status.

Recyclable

A material that can be recycled.

Safety

The way that a person works with tools, materials and equipment that does not harm themselves or others physically.

Science

The study and description of natural phenomena.

Shaping

A process used to change the shape or contour of materials – shaping always involves the removal or addition of material.

SKA – Square Kilometre Array

The world's largest radio telescope made up of over 2500 dish antennae (most in South Africa). It will be used to study distant parts of the universe and will provide many opportunities in technological and scientific related careers.

Specification

An organised, detailed description of the requirements/criteria that the solution or product must meet, e.g. safety, size, material, function, human rights, environment, etc.

Note: Once a product has been manufactured, the original design specifications become the ***features*** of the product, i.e. specifications before = features after.

Structure

Something that has been built, made or been put together in a particular way.

System

Something that is made up of interlinked parts that function together as a whole to accomplish a goal. For example a mechanical system has a combination of mechanisms that make it function as a whole; an electrical system has interrelated electrical parts that work together to make the system do what it was designed to do.

Tabulate

Arrange data or information in the form of columns and rows.

Technological capability

The ability to use a combination of skills, knowledge, resources in a variety of contexts, to solve a technological problem. Capability leads to technological literacy.

Technological solution

A plan that arises by using a systematic problem solving process (ideas, flowcharts, models, etc.).

Technological literacy

The ability to use, understand, manage and evaluate technology.

Technological processes

Any process using technology to perform a task e.g. generating electricity, extracting iron from iron ore, galvanising steel by electroplating, injection moulding a plastic bucket, etc.

Tension

A force that stretches an object or material, a pulling force.

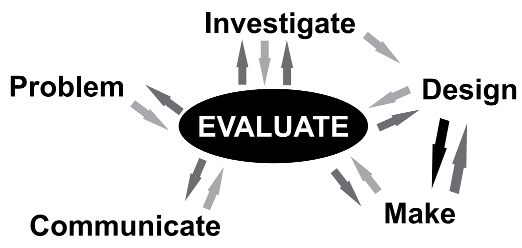
Want

Something that people would like but do not actually need (a convenience or a luxury).

ANNEXURE E: THE DESIGN PROCESS

The Design Process is not linear, usually cyclical. Often it is driven by evaluation.

Evaluation at each stage determines the next step.



Investigate	Problem/need/want Context/impact Research/questionnaire/interview Materials/suitable tools/required skills
Design	Initial ideas Free-hand sketches Design Brief with Specifications and Constraints Plan using systems diagram Trial modelling Budget
Make	Choose tools/method/materials/resources Draw formal plans Draw flow charts/sequence of manufacture Make prototype/model/final product (considering safe working procedures)
Evaluate	Evaluate severity/urgency of problem/need/want. Analyse solution using a systems diagram Evaluate solution in terms of design brief, specifications and constraints Evaluate product/process/manufacturing method/safety Evaluate impact/bias/an indigenous solution
Communicate	Report Present Advertise/poster using artistic graphics

ANNEXURE F: CALCULATING MARKS

Technology is a subject with a vital practical component.

In the GET Band, while the subject is general, it has four foci, which may lead to specialisation in the FET Band.

Unlike the FET Band where each specialisation has one PAT (Practical Assessment Task) making up 33,3% of the Final Examination mark (25 out of 75), in the GET Band each of the foci has a Mini-PAT which *together* will make up 33,3% of the Final Examination mark (20 out of a possible 60).

Table 1: Formal Assessment in Grades 7, 8 and 9 Technology				
	INFORMAL DAILY ASSESSMENT	**FORMAL ASSESSMENT : TERM MARKS**		
		Practical Tasks & Theory Test / Examination		**TOTAL**
	Enabling Tasks	**Mini-PAT**	**Term Test / Examination**	**Term Mark**
Term 1	0%	70%	30%	100%
Term 2		70%	30%	100%
Term 3		70%	30%	100%
Term 4		70 marks = 100%	No Test	100%
Promotion Mark	**CASS Component: 40%**	**Final Examination Component: 60%**		**Promotion**
	Continuous Assessment : Test & Mini-PATs **40**	**Combined Mini-PAT: 20**	**Examination: 40**	
	Term1 + Term2 + Term3 + Term4	T1 + T2 + T3 + T4	**40**	**100**
	10 + 10 + 10 + 10	**5 + 5 + 5 + 5**		

Example: Learner A in Grade XXX builds up the following CASS Mark record over the year:

Learner A	**Term 1**	**Term 2**	**Term 3**	**Term 4**		**CASS MARK**
Mini-PAT	50 out of 70	40 out of 70	45 out of 70	40 out of 70		40
Test	15 out of 30	20 out of 30	25 out of 30	No Test		
Term Mark	65%	60%	70%	57%		252¸10 = 25,2 (10 per term)
The CASS Marks count 40% of the Year Mark i.e. each Term contributes 10%.						

The Mini-PATs constitute $^1/_3$ Practical Component of the Final Examination Mark i.e. 20 out of 60.

Learner A	**Term 1**	**Term 2**	**Term 3**	**Term 4**	**Practical out of 20**
Mini-PATs	50/70 = 71%	40/70 = 57%	45/70 = 64%	40/70 = 57%	**249/20 = 12,45**

CASS Component	**= 25,20**		**40**
Practical Exam Component (Mini-PATs)	**= 12,45**	**20**	**60**
Theoretical Exam Component	**= 20,00**	**40**	
Total Year Mark:	**57,65**		**100**
Promotion %	**58%**		**100%**

TECHNOLOGY MARK SHEET

Grade 9A	**Term 1**			**Term 2**			**Term 3**			**Term 4**		**CASS`**	**Practical**	**Theory**	**Final**
													Examination		
	Mini-PAT	Test	%	Mini-PAT	Test	%	Mini-PAT	Test	%	Mini-PAT	%	**40**	**20**	**40**	**%**
Names	**70**	**30**	**100**	**70**	**30**	**100**	**70**	**30**	**100**	**70**	**100**				
Learner A	50	15	**65**	40	20	**60**	45	25	**70**	40	**57**	25,2	12,45	20	**58**
			Report			Report			Report						Report

FORMULAE:

TERM Marks: Reports 1, 2, and 3 for the first three terms: Simply add the Mini-PAT (out of 70) to the Test (out of 30) and you have the Term Percentage.

Year-end Report:

1. CASS Mark: Add the FOUR term marks and ***multiply*** the total by 0,4 to get a mark out of 40.

2. Practical Exam Component: Add the FOUR Mini-PAT marks out of 70 and ***divide*** the total by 14 to get a mark out of 20

3. Theory Exam Component: Convert the Theory Exam mark to a mark out of 40 as follows:

EITHER ***Multiply*** the exam **percentage** by 0,4 to get a mark out of 40

4. Promotion Mark: CASS Mark (out of 40) **+** Practical Exam Component (out of 20) **+** Theory Exam Component (out of 40) **= 100%**

Note: Converting the Exam Mark to a percentage

For Grade 9: ***Divide*** the exam mark out of 120 by 1,2 to get a %

For Grade 8: ***Divide*** the exam mark out of 100 by 1,0 to get a %

For Grade 7: ***Divide*** the exam mark out of 60 by 0,6 to get a %

ANNEXURE G: PLANNING FOR ASSESSING CONSIDERING COGNITIVE LEVELS

RECALL	UNDERSTANDING	APPLICATION	ANALYSE	SYNTHESISE	EVALUATE
ROUTINE	DIAGNOSTIC	STRATEGIC	INTERPRET	CREATE	
Low Order	Middle Order		Higher Order		
30%	40%		30%		
Count Define Identify Label List Match Name Outline Point out Quote Recite Repeat Reproduce Select State Trace	Classify Compare Convert Discuss Distinguish Define Describe Estimate Generalise Give examples Illustrate Infer Interpret Match Paraphrase Restate Rewrite Select Summarise	Change Compute Construct Demonstrate Draw Illustrate Predict Relate Solve Use	Breakdown Differentiate Discriminate Investigate Relate Separate Subdivide	Arrange Combine Compile Construct Create Design Formulate Generalise Generate Group Integrate Organise Summarise	Appraise Conclude Construct Critique Criticize Decide Evaluate Grade Justify Interpret Support Recommend

ANNEXURE H: MODERATION GRID FOR AN ASSESSMENT TASK

School : ________________________ Date :_________________________

Subject : **Technology**

SKV	Focus Area	Knowledge (*OHS)	Comprehension/ understanding	Application	Analysis	Synthesis	Evaluation	Form of assessment	Mark allocation
		Low order	Middle order		High order				
Skills	Investigate								
	Design								
	Make								
	Evaluate								
	Communicate (including – reports and presentation)								
Knowledge	Structures								
	Processing								
	Mechanical S/C								
	Electrical S/C								
Values	Indigenous								
	Impact (Environment: social, natural, economic)								
	Bias								