MECHANICAL TECHNOLOGY

National Curriculum Statement (NCS)

Curriculum and Assessment Policy Statement

Further Education and Training Phase Grades 10-12

basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

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CURRICULUM AND ASSESSMENT POLICY STATEMENT
GRADES 10-12

MECHANICAL 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 STATEMENTS FOR MECHANICAL TECHNOLOGY GRADES 10-12

1.1 Background

The *National Curriculum Statement Grades R-12 (NCS)* stipulates policy on curriculum and assessment in the schooling sector.

To improve implementation, the National Curriculum Statement was amended, with the amendments coming into effect in January 2012. A single comprehensive Curriculum and Assessment Policy document was developed for each subject to replace Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines in Grades R-12.

1.2 Overview

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

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

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

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

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

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

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

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contemplated in subparagraphs b(i) and (ii) comprise the following policy documents which will be incrementally repealed by the *National Curriculum Statement Grades R-12 (January 2012)* during the period 2012-2014:

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

(ii) The policy document, National Policy on assessment and qualifications for schools in the General Education and Training Band d, 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

MECHANICAL TECHNOLOGY

2.1 What is mechanical technology?

Mechanical Technology focuses on concepts and principles in the mechanical (motor, mining, shipping, rail, power-generation, etc.) environment and on technological processes. It embraces practical skills and the application of scientific principles. This subject aims to create and improve the engineering and manufacturing environment to enhance the quality of life of the individual and society and ensure the sustainable use of the natural environment.

2.2 Specific aims

- The learner in Mechanical Technology needs to be interested in any form of mechanical entities. It can be cars, planes, trains, welding, maintenance, etc.
- In order to be successful the learner also has to enrol preferably in Mathematics, Physical Science and Engineering Graphics and Design, as they all form part of the technical studying field.
- Mechanical Technology in essence is applied science, as the field of work includes trigonometry, Newton's laws and chemical equations when dealing with certain welding techniques, fuel combustion, fuel injection, cooling systems, etc.

The main topics in Mechanical Technology are:

- safety - Occupational Health and Safety (OHS) Act;
- tools and equipment;
- materials - ferrous and non-ferrous materials and alloys and the iron-carbon equilibrium diagram;
- terminology - manufacturing processes with reference to lathes (diameter turning, taper cutting, screw cutting) and milling machines (cutting methods, dividing head, centring of cutter);
- joining methods - permanent (welding) and semi-permanent (bolts, nuts and rivets) joints;
- forces - forces, moments, Young's modulus, stress and strain;
- maintenance;
- systems and control:
    - mechanical - gears, belts, pulleys, power transmission, chains, clutches, cams, levers, etc;
    - hydraulics - pistons, valves, Pascal's law;
    - pneumatics;
    - electrical wiring - starting and charging circuits; and
    - electronic applications - anti-lock braking system (ABS), fuel injection, air bag control, etc.;

- engines - diesel and petrol, four and two stroke;
- pumps - centrifugal, water; and
- turbines - super and turbo chargers, gas and steam turbines.

2.3 Requirements for Mechanical Technology

(a) Each learner should have

i. a textbook;

ii. access to a variety of mechanical engineering and industrial magazines and reference books;

iii. drawing equipment; and

iv. a calculator.

(b) Learners should have access to computers with a CAD programme at school.

(c) The school should subscribe to at least one or two industrial and mechanical engineering magazines for the teacher to keep abreast with the latest developments in the industrial environment. These magazines could also be lent out to learners (in the same way as library books). These resources must be readily available in the classroom or in the library.

(d) The teacher should have a variety of reference books, charts and brochures in the classroom to stimulate the learners' interest in the subject.

(e) The teacher should have access to the internet to be able to source, download and print relevant and new information, as the industry environment is a dynamic one with new trends and developments. The teacher should also have electronic mail facilities, as new information from subject advisors and other sources need to be downloaded via electronic mail. The teacher needs to be trained on the context and content of the subject.

(f) Schools offering Mechanical Technology must have a well-equipped workshop for learners to complete the practical assessment tasks. The classroom/workshop needs to be secure, with doors that lock, and burglar-proof. Enough storage space should be available to store and lock all resources. Resources to offer Mechanical Technology as a subject are the responsibility of the school. The school should build up a collection of models, e.g. by asking learners, parents or mechanical, electrical and electronic repair workshops and suppliers to donate models.

(g) Subject advisers must provide regular support to the teachers.

2.4 Career opportunities in Mechanical Technology

- Apprenticeship as a motor mechanic, fitter and turner, welder, boiler maker, tractor mechanic, etc.
- Engineering studies in the fields of aviation, air-conditioning, motor cars, engines, ship building, power systems, electrical power stations, etc.
- Studies at Universities of Technology in various mechanical streams
- Entering the world of work as an entrepreneur in various fields such as precision machining, programming of lathes and milling machines, fitment of accessories to cars and trucks to enhance performance, maintenance of many different mechanical installations
- Research and development of new and current entities in the mechanical field of work
- Mechanical Technology does not have the distinction of being a grade 12 exemption subject; it has the advantage of giving the learner the background of what is expected from them when enrolling in any mechanical study opportunities.

SECTION 3

3.1 Content outline for Mechanical Technology

Table 1: OVERVIEW OF PROGRESSION OF TOPICS AND CONTENT ASSIGNED TO GRADES 10-12			
TOPIC	**GRADE 10**	**GRADE 11**	**GRADE 12**
SAFETY	Identification and prevention of hazardous conditions; good housekeeping; safe practices and good personal habits	OHS Act applicable to different tools and equipment	OHS Act applicable to different tools and equipment
TOOLS	Basic tools and equipment; measuring instruments	The principles and functions of purpose-made tooling and equipment such as dial indicators, micrometers, torque wrenches and stocks and dies	Principles and functions of advanced engineering equipment such as analysers, testers, measuring instruments
MATERIALS	Ferrous metals and alloys; low, medium and high carbon steel; cast iron, grey cast iron, white cast iron; non-ferrous elements; non-ferrous alloy; thermo-plastic composites; thermo-hardened composites	Manufacturing of steel; properties of materials; enhancing properties of steel	The iron-carbon equilibrium diagram
TERMINOLOGY	Drilling machine; lathe (parts and functions, facing and centre drilling; diameter turning) Milling machine (parts and functions, movements of table and types of cutters)	Taper turning (lathe); dividing head (milling)	Screw cutting (lathe) and cut of gears and keyways (millings) and milling processes
JOINING	The uses of semi-permanent joining applications, bolts, nuts, studs, locking devices	Permanent (arc, gas, MIG), symbols, welding joints	Application of MIG welding, defects and tests (destructive and non-destructive)
FORCES	Different types of forces, moments and stresses (solid bars) found in engineering components	System of forces (two or more), moments (two forces on a beam) and stresses (hollow pipes) found in engineering components	System of four forces acting, beams for a uniform load, stress and strain and Young's modulus
MAINTENANCE	The effect of lack of maintenance on operating systems; friction and types of maintenance	Analysis of the causes of malfunction of operating systems and alignment on vehicles	Properties of lubricants, grading of oil, maintenance on clutches, belt and chain drives

Table 1: OVERVIEW OF PROGRESSION OF TOPICS AND CONTENT ASSIGNED TO GRADES 10-12			
TOPIC	**GRADE 10**	**GRADE 11**	**GRADE 12**
SYSTEMS AND CONTROL	Mechanical: identify different types of gears, pulleys, belts, etc. Hydraulics / pneumatics: symbols and diagrams on simple hydraulic systems Electrical/electronic control: Warning lights, sender units, gauges	Mechanical components: advantages, disadvantages, velocity calculations and operating principles of different drives Hydraulics/Pneumatics: use, description and calculations Electrical / Electronic Control: basic operating principles of ignition timing, fuel injection, charging and starting circuits	Mechanical: simple calculations related to power transmission systems on gears, pulleys and belts Hydraulics: basic calculations on double-acting pistons and reservoirs (hydraulic jack/lift) and Boyle's law Electrical/Electronic Control: basic operating principles of electronic control systems (ECU), ABS, air bag, central locking
ENGINES, PUMPS AND TURBINES	Four stroke and two stroke petrol and diesel engines, components of engines	Operating principles of pumps	Operating principles of gas and steam turbines and turbo and super chargers.

3.2 Content outline per term for Mechanical Technology

Tables 2, 3 and 4 show the time allocation in weeks for the different topics and the contents for Grades 10, 11 and 12.

Table 2 - GRADE 10

Four hours of contact time is prescribed per week. 2 ½ hours is intended for theory and 1 ½ hours for practical work and completion of the PAT. (One double period is required for practical work)

GRADE 10 TERM 1		
TIME	**TOPIC**	**CONTENT**
3 Weeks **(12 hours)**	**SAFETY**	**Understanding of the OHS Act** Learners must be fully aware of all the safety precautions to be taken during performance-based activities, in order to avoid injuries or incidents. Refer specifically to the following tools/ machines/equipment: • Different hand tools • Pedestal drill • Lathe • Milling machine • Bench grinder • Guillotine • Bending machine • Power saws **Identification of hazardous conditions and precautions to avoid injuries and accidents:** • Good housekeeping, machine guards, covering of transmission belts, protruding shaft ends and avoid sharp edges • No adjustment or maintenance on running machines • Proper and safe stacking of objects • Proper lighting • Clean and dry workplace, floor space, condition of floors • Working at safe speed • Safe electrical extensions • Using tools within capacity limits • Safe practices and good personal habits, protective equipment and clothing • Safety switches, colour coding and signs • Emery wheels, cutting discs and grinding equipment
1 Week **(4 hours)**	**TOOLS**	**The principles and functions of appropriate basic tools and equipment (selection, use and care)** • Spanners: ring, flat and combination • Sockets and accessories • Pliers: combination, circlip, diagonal, long nose and water pump pliers • Chisels, hammers, hacksaws, scribers, punches, steel rulers, engineering squares, measuring tapes and combination set • Screwdrivers: flat, Phillips/star and off set • Files, smooth and bastard: flat, square, triangle, round and half-round shapes • Measuring instruments (simple readings from the instruments): • Verniers • Outside micrometers - 50 mm

TIME	TOPIC	CONTENT
1 Week (4 hours)	**MATERIALS**	**Reason for using certain engineering materials by taking environmental aspects into consideration** **Characteristics, composition and use of:** • Ferrous metals and alloys: - Low, medium and high carbon steel - Cast iron, grey cast iron, white cast iron - Stainless steel (chromium), manganese, vanadium, titanium and tungsten • Non-ferrous elements: - Copper, tin, lead, zinc and aluminium • Non-ferrous alloy - Yellow copper, bronze, phosphor bronze, white metal, duralumin • Thermo-plastic composites - Nylon; Teflon - Poly-vinyl composite (PVC) - Vesconite • Thermo-hardened composites - Carbon and glass fibre - Bakelite **Tests to distinguish between materials (distinguish between materials according to their properties)** • Visual inspection of general appearance such as colour and texture • Density (weight) • Sound test • Filing test • Spark test • Break test
TIME	**TOPIC**	**CONTENT**
3 Weeks (12 hours)	**TERMINOLOGY**	**Appropriate terminology and procedures used in the subject including lathes and milling machines** South African National Standards (SANS) as applicable to Mechanical Technology, but not limited to only SANS. **Cutting procedures for the following:** • Lathe - Parts and functions - Facing, parallel turning and centre drilling - Diameter turning • Milling machine - Parts and functions - Movements of table - Identification of the different types of cutters (end mills, flute cutters, side and face cutters, helical cutters) • Drilling machine - Parts and functions Applying manufacturing processes such as facing and parallel cutting methods on a lathe to make a basic artefact according to instructions and/or basic drawings.
2 Weeks (8 hours)	**TEST**	**Control Test: 50 marks : 1 hour** **PAT: (phase 1 *(Terminology/ Manufacturing task)* 50 marks** **Plan and prepare for PAT final task: Phase 4: 100 marks**

GRADE 10 TERM 2		
TIME	**TOPIC**	**CONTENT**
3 Weeks **(12 hours)**	**JOINING METHODS**	**The uses of semi-permanent joining applications:** Simple calculations on the size of drills and keyway sizes • Bolts • Studs • Locking devices such as tapers i.e. large diameter drills using Morse taper socket • Nuts • Split pins • Rivets • Keys Using working instructions and applying to basic relevant joining methods Semi-permanent joining applications: Demonstrating the correct interpretation of terminology by using the given criteria and then making a lap joint by using a variety of jointing techniques, which include rivets, bolts, nuts and other semi-permanent locking devices
4 Weeks **(16 hours)**	**FORCES**	**Different types of forces found in engineering components:** • Pulling force (tensile) • Compressive force • Shearing force **Basic calculations of forces:** Mathematical calculations and graphical solutions to determine (for a maximum of two forces): • Horizontal and vertical components of a force acting at an angle • Triangle and parallelogram of forces • Resultant forces **Moments found in engineering components:** Definition - Moment = force x perpendicular distance **Basic calculations** on simple acting levers such as a spanner used to tighten a nut or bolt **Basic principle and calculations of stress:** Definition: Stress = force per square unit of surface Stress in a: • Square bar • Round bar **Performing basic tests on various mechanical principles** *Testing of concepts*: Forces, pressure and torque using gauges, meters and instruments
3 Weeks **(12 hours)**		**PAT: Phase 2** ***(Joining task) 50 marks*** **PAT final task: Phase 4 under construction: 100 marks** Mid-year examination 150 marks : 3 hours

GRADE 10 TERM 3		
TIME	**TOPIC**	**CONTENT**
1 Week **(4 hours)**	**MAINTENANCE**	**The effect of lack of maintenance on operating systems** **Characteristics of friction:** • Magnitude of forces • Surface roughness • Speed of movement • Size of contact areas **Types of maintenance:** • Preventive • Predictive • Reliability-centred maintenance **Consequences of lack of maintenance:** • Excessive wear • Overheating/seizing and distortion (lack of cooling and lubrication) • Failure e.g. hydraulics/pneumatics, controls and cables **Detection of signs of wear on components of mechanical systems** • Observation of excessive wear, overheating, seizing and distortion on different components • By means of basic routine maintenance • By means of condition monitoring (e.g. oil analysis, vibration monitoring, thickness testing, infra-red hot spot detection), crack analysis
6 Weeks **(24 hours)**	**SYSTEMS AND CONTROL**	**Functions of components applicable to different operating systems and the control thereof, mechanical, hydraulic and pneumatic systems** **Different types of:** • Gears • Pulleys • Belts • Chain drives **Basic velocity calculations on:** • Gears, (N1T1=N2T2) (two gears) • Pulleys, belts (N1D1=N2D2) **Identification and description of:** • Clutches - single plate, dry (automotive) • Levers, Class 1, 2 and 3 • Cams

TIME	TOPIC	CONTENT
	SYSTEMS AND CONTROL (continued)	**Basic systems and control** • Experiment with levers and linkages. • Experiment with gear and pulley ratios as found in practice on electrical press drills, lathes and other manual gearboxes. • Investigate examples of components of oil pumps, fuel pumps and valves. • Investigate examples driven by cams (timing and synchronising), wheels, axles and differentials. **Hydraulics/Pneumatics** • Symbols for a simple hydraulic system • Simple hydraulic diagrams to explain the functioning of hydraulic systems • Experimentation with hydraulic and pneumatic equipment (kits) to demonstrate how mechanical advantage can be achieved. Automatic gearboxes, torque converters, power steering, brake systems are practical applications of these principles **Electrical/Electronic control** • Warning lights - Brake lights - Hand brake - Flicker unit • Sender units - Oil pressure sender unit • Gauges - Fuel gauge - Temperature gauge **Basic systems and control** • Experimentation with warning light circuits, sender units and gauges.
1 Week (4 hours)		PAT (Phase 3 (Maintenance/ Experimentation/ Simulation task) 50 marks PAT phase 4: Final task completed: 100 marks Moderation commences
2 Weeks (8 hours)		Consolidation and control test 50 marks: 1 hour

GRADE 10 TERM 4		
TIME	**TOPIC**	**CONTENT**
6 Weeks **(24 hours)**	**HEAT ENGINES**	**The operating principles of heat engines** Internal combustion engine: Comparing the operating principles and construction of: • Four stroke and two stroke SI (petrol) engines • Four and two stroke CI (diesel) engines **Main components:** • Pistons, rings, crankshaft, connecting rod, gudgeon pin, camshaft, cylinder block, cylinder head • Cam and crank gears, valves, bearings, distributor, spark plug • Advantages and disadvantages of petrol injection, • Carburettor, advantages of petrol injection in comparison to carburettor, starter, alternator, coil • Inlet and exhaust manifolds • Compression ignition (diesel) engines. • Comparison between four and two stroke engines with reference to construction and cycles
4 Weeks **(16 hours)**		**Final examination** **200 marks : 3 hours**

Table 3: GRADE 11

Four hours of contact time is prescribed per week. 2 ½ hours is intended for theory and 1 ½ hours for practical work and completion of the PAT. (One double period is required for practical work)

GRADE 11 TERM 1		
TIME	**TOPIC**	**CONTENT**
3 Weeks **(12 hours)**	**SAFETY**	**The OHS Act:** Analysing the OHS Act and regulations and applying all relevant safety measures, as applicable to the following: Machine-specific safety measures when dealing with - • Machine tools • Grinding machines (portable, bench and surface) • Cutting machines(drilling machines, power saw, lathes and milling) • Shearing machines (manual and power-driven) • Press machines • Joining equipment (arc, spot, gas) • Handling and storage of gas cylinders
1 Week **(4 hours)**	**TOOLS**	**The principles and functions of the following purpose-made tooling and equipment (selection, use and care of tools and equipment):** • Dial indicators • Inside micrometers (simple readings from the instruments, use of attachments) • Telescopic gauges • Torque wrenches • Stocks and dies (characteristics and drill sizes) • Grinding machines (portable, bench and surface) • Cutting machines (drilling machines, power saw, lathes and milling) • Shearing machines (manual and power-driven) • Press machines • Joining equipment (arc, spot, gas) • Gas cylinders (oxygen, acetylene, argon, helium, nitrogen)

TIME	TOPIC	CONTENT
2 Weeks **(8 hours)**	**MATERIALS**	**Use of certain engineering materials by taking environmental aspects into consideration** **Manufacturing of steel:** • Blast furnace • Open-hearth furnace • Bessemer converter **Properties of engineering materials:** • Hardness • Plasticity • Elasticity • Ductility • Malleability • Brittleness • Toughness **Methods of enhancing the properties of steel as well as applying relevant measures and demonstrating competency in the following heat treatment processes:** • Tempering • Case hardening • Hardening • Annealing • Normalising
2 Weeks **(8 hours)**	**TERMINOLOGY**	**Appropriate terminology and procedures used in the subject, including lathes and milling machines** **Cutting procedures for the following:** • Lathe - Taper turning (compound slide method) • Milling machine with dividing head. Calculations on: - Centring of cutter - the use of dial gauges only - Indexing for a square, pentagon and hexagon - Types of indexing: o Rapid o Simple instructions and drawings and applying different cutting methods to make an artefact, which include taper turning and simple cutting methods on the milling machine
2 Weeks **(8 hours)**		**Control Test: 50 marks : 1 hour** **PAT: (phase 1 (Terminology/ Manufacturing task) 50 marks** **Plan and prepare for PAT final task: Phase 4: 100 marks**

GRADE 11 TERM 2		
TIME	**TOPIC**	**CONTENT**
3 Weeks **(12 hours)**	**JOINING METHODS**	**Uses of permanent joining applications** **Welding joint symbols:** • Welding symbols • Fillet weld • Square butt weld • V-butt weld • Bevel weld • U-butt weld • J-butt weld **Applications:** • Soft and hard soldering • Gas welding (oxy-acetylene) • Arc welding • Spot welding **A cross-sectional view of a welding joint indicating:** • Parent (base) metal • Slag • Heat-affected area • Welding material **Factors influencing the welding joint:** • Type of material • Number of welds • Type of welding rod • Size of weld • Presence of oxygen/hydrogen • Preparation **Using working instructions and applying complex but relevant joining methods** • The correct interpretation of terminology by using the given criteria • Manufacturing of joints by using a variety of jointing techniques, which includes soft and hard soldering, gas welding (oxy-acetylene), arc and spot welding

TIME	TOPIC	CONTENT
4 Weeks **(16 hours)**	**FORCES**	**Different types of forces found in engineering components by mathematically and graphically determining the nature of these forces** **Basic calculations of:** **Forces found in engineering components:** • System of forces (maximum of three forces) • Resultant and equilibrant **Moments found in engineering components (by calculation only):** A simply supported beam with two vertical point loads acting on the beam (including reactions at the supports) **Basic calculations on stress:** • Square tubing • Round tubing **Performing basic testing on various mechanical principles.** **Testing of concepts** - Bending moments and stresses, using gauges and meters
3 Weeks **(12 hours)**		**PAT: Phase 2** *(Joining task) 50 marks* **PAT final task: Phase 4 under construction: 100 marks** **Mid-year examination** **150 marks: 3 hours**

GRADE 11 TERM 3		
TIME	**TOPIC**	**CONTENT**
2 Weeks (8 hours)	**MAINTENANCE**	**The effect of lack of maintenance on operating systems** **Analysis of the malfunction of operating systems** • Lack of lubrication or incorrect lubrication • Overloading • Friction • Balancing (wheel and crankshaft vibration dampers) **Alignment** • Toe-in and toe-out on wheel alignment • Castor and camber • Kingpin inclination • Ackermann principle (toe-out on turns) **Identification of signs of wear on components of mechanical systems** Evaluation and reporting on the deterioration of various mechanical components Monitoring the conditions of components in various mechanical systems and performing fault-finding procedures on fuel systems and ignition circuits • Overloading • Balancing; • Alignment • Timing

TIME	TOPIC	CONTENT
5 Weeks **(20 hours)**	**SYSTEMS AND CONTROL**	**The functions of components applicable to different operating systems and the control thereof; mechanical, hydraulic and pneumatic systems** **Analysis of the operation of components:** **Mechanical:** Uses, functions, advantages and disadvantages of the following drives: • Gear, pulleys, belts, chains, cables • Threads and linkages, wheels and axles **Basic velocity calculations of:** • Gears (compound) including idler gears • Pulleys, • Belts (v-belts) **The operating principles of:** • Clutches - operation with a pressure plate (multi-plate) • Levers and linkages (clutch and brake operation) • Cams - engine / valve operation • Eccentric action (fuel pump drive) **Hydraulics/Pneumatics** **Basic calculations on:** • Pistons and reservoirs (only a single cylinder) **Uses and description of:** • Valves, pipes, pressure gauges, pistons and reservoirs. **Electrical/Electronic control** Basic operating principles of: • Ignition timing - procedure • Starting and charging circuit • Fuel injection • Mechanical, hydraulic (brakes), and pneumatic systems as found on equipment and vehicles
1 Week **(4 hours)**		**PAT Phase 3** ***(Maintenance/ Experimentation/ Simulation task) 50 marks*** **PAT phase 4: Final task completed: 100 marks** **Moderation commences**
2 Weeks **(8 hours)**		**Consolidation and control test** **50 marks: 1 hour**

GRADE 11 TERM 4		
TIME	**TOPIC**	**CONTENT**
6 Weeks **(24 hours)**	**PUMPS**	**The operating principles of pumps** • Mono pumps • Centrifugal pumps • Reciprocating pumps • Gear pumps • Vane pumps • Rotor pumps
4 Weeks **(16 hours)**		**Final examination** **200 marks: 3 hours**

Table 4: GRADE 12

Four hours of contact time is prescribed per week. 2 ½ hours is intended for theory and 1 ½ hours for practical work and completion of the PAT. (One double period is required for practical work)

GRADE 12 TERM 1		
TIME	**TOPIC**	**CONTENT**
3 Weeks (12 hours)	**SAFETY**	**The OHS Act** Application of the OHS Act and regulations where applicable to the following machines (refer to the Grade 11 content): • Grinding machines (portable, bench and surface) • Cutting (drilling machines, power saw, lathes and milling machines) • Shearing machines (manual and power driven) • Press machines • Joining (arc, spot, gas) • Handling and usage of gas cylinders **Specific safety measures when dealing with the following machines and equipment:** • Metal arc gas-shielded welders (CO2 and Argon); • Hardness testers (Brinnel and/or Rockwell); • Tensile testers • Torsion tester • Moments and forces testers • Beam bending tester • Cylinder leakage and pressure testers • Spring compressors and testers (valve and coil); • Gas analysers • Multimeter • Lathes and milling machines, bearing and gear pullers
1 Week (4 hours)	**TOOLS**	**Principles and functions of advanced engineering equipment and selection, use and care of appropriate tools and equipment** • Gas analysers • Brinnel hardness testers • Multimeter • Pressure testers (cooling, oil and fuel) • Cylinder leakage testers • Torsion testers; moments and forces testers • Beam bending testers; tensile testers • Compression testers • Spring testers • MIG/MAG welders **Simple calculations with:** • Depth micrometer • Screw thread micrometer (included angle)

TIME	TOPIC	CONTENT
1 Week **(4 hours)**	**MATERIALS**	**Reasons for using certain engineering materials by taking environmental aspects into consideration** **Description and explanation of the iron-carbon equilibrium diagram with reference to:** • Carbon content • Temperature • Austenite • Ferrite • Cementite • Pearlite • Lower and higher critical temperature Explanation of the typical characteristic changes at: • AC_1 • AC_2 • AC_3 Identification of material uses with enhanced properties (tempering and case hardening) in practical applications (e.g. crankshafts, camshafts and piston rings)
3 Weeks **(12 hours)**	**TERMINOLOGY**	**Demonstration and understanding of appropriate terminology and procedures used in the subject, including lathes and milling machines** Applying correct terminology in the proper context of SANS as applicable to Mechanical Technology, but not limited to only SANS. **Cutting procedures for the following:** • Lathe - Screw cutting (outside) metric V thread up to 3 mm pitch. Cross-slide method only (include basic screw thread terminology, cutting depth calculation only) • Milling machine. Calculations on: - Cutting of a gear using only simple indexing - Keyways. • Types of milling processes : - Up-cut, down cut, straddle and gang-milling. Using advanced instructions and/or drawings and applying different cutting methods to make an artefact using cutting methods on the lathe and milling machine
2 Weeks **(8 hours)**		**Control Test: 50 marks : 1 hour** **PAT: (phase 1** *(Terminology/ Manufacturing task) 50marks* **Plan and prepare for PAT final task: Phase 4: 100 marks**

Table 4.2: GRADE 12 TERM 2		
TIME	**TOPIC**	**CONTENT**
2 Weeks **(8 hours)**	**JOINING METHODS**	**Analysis of the possible defects of welding joints by visual inspection:** **Applications:** • MIG/MAGS welding **Defects:** • Porosity • Slag inclusion • Welding craters • Incomplete penetration • Undercutting • Faulty restart **Destructive tests:** • Nick break • Nick bend • Machinability tests **Non-destructive tests:** • Visual inspection • X-rays • Dye penetration • Ultrasonic test **Applying advanced permanent joining applications** **Manufacturing of various joints using a variety of joining techniques, which includes gas metal arc welding** **Visual inspections of welded joints**

Table 4.2: GRADE 12 TERM 2		
TIME	**TOPIC**	**CONTENT**
5 Weeks **(20 hours)**	**FORCES**	**Basic calculations of:** **Forces found in engineering components:** • System of forces (maximum of four forces) • Resultant and equilibrant **Moments found in engineering components (by calculation only):** A simply supported beam with two vertical point loads and one uniformly distributed load acting on the beam (including reactions at the supports) **The concepts of stress, strain and modulus of elasticity** **Calculation of:** • Stress and strain (Hooke's law) • Compressive/tensile stresses • Young's modulus of elasticity (ignore factor of safety) • Change in length (Δl) • Stress/strain diagram **Performing advanced tests on various mechanical principles** Testing of complex concepts such as bending moments, shear forces, stresses, strains and elasticity using gauges and meters
3 Weeks **(12 hours)**		**PAT: Phase 2** *(Joining task) 50 marks* **PAT final task: Phase 4 under construction: 100 marks** **Mid-year examination** **200 marks : 3 hours**

Table 4.3: GRADE 12 TERM 3		
TIME	**TOPIC**	**CONTENT**
1 Week **(4 hours)**	**MAINTENANCE**	**The effect of a lack of maintenance on operating systems** **Identification of the most suitable preventative maintenance in operating systems** **Properties of lubricants:** • Viscosity • Pour point • Flash point **Grading of oil according to viscosity (SAE standards):** • Transmission oil • Engine oil • Differential oil • Cutting fluid • Grease **Belt and chain drives and clutches:** • Maintenance of belt and chain drives • Maintenance of clutches Suggesting applicable repair methods and adjustments to various systems **Relevant methods of repairing for:** • Maintenance of belt and chain drives • Maintenance of clutches

TIME	TOPIC	CONTENT
4 Weeks (16 hours)	**SYSTEMS AND CONTROL**	**Simple calculations related to power transmission systems on the following:** **MECHANICAL:** • Gears (compound), including idler gears • Power transfer • Pulleys • Belts (v-belts, flat belts) **HYDRAULICS** **Basic calculations on:** • Double-acting pistons and reservoirs (hydraulic jack/lift) • Boyle's law **Electrical/Electronic control** **Basic operating principles of:** • Vehicle management systems / ECU • ABS brakes • Traction control • Air bag control • Central locking **Demonstration of competency on advanced systems and control** **Relevant methods of repairing:** • *Integrated electrical/mechanical systems*: e.g. electronic ignition, ABS (theory only); • *Ignition (spark)*: fuel, the machine must rotate (rotor/valves), power supply (battery); • *Hydraulics*: fluid, pressure, relief valves, pistons, seals, pipe connections that are used in brakes, hydraulic presses and jacks; and • *Pneumatics*: vacuum, pressure, valves, pistons, diaphragms, vacuum meters used in motor vehicles and industry.
1 Week (4 hours)	**TURBINES**	**Types of turbines, their components and the function thereof:** • Water turbines • Steam turbines • Gas turbines • Turbochargers **Operating principles of turbines:** Principles of turbines : • Water turbines • Steam turbines • Gas turbines • Turbochargers • Super chargers
4 Weeks (16 hours)		**PAT (Phase 3** *(Maintenance/ Experimentation/ Simulation task) 50 marks* **PAT phase 4: Final task completed: 100 marks** **Commencement of moderation** **Preparatory examination** **200 marks: 3 hours**

Table 4.4: GRADE 12 TERM 4		
TIME	**TOPIC**	**CONTENT**
4 Weeks **(16 hours)**	**Consolidation**	**Consolidation**
5 Weeks **(20 hours)**		**Final examination** **200 marks: 3 hours**

SECTION 4

4.1 Introduction

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

Assessment involves activities that are undertaken throughout the year. In Grades 10-12 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.

Evidence of all assessments including tests, simulations and tasks should be placed in the learner's script. It is imperative that all items are marked clearly. Items that are loose should be pasted into the script to become a permanent part of a learner's record.

All items in the learner script must contain the following references:

- Date
- Topic
- Homework assignments including a textbook page and exercise reference
- Evidence of scrutiny and interaction from the teacher in red pen
- All teacher actions/interventions in the script should be dated
- Learners are required to mark all self-assessments in pencil and all corrections must be shown in pencil.

As the script is a formal assessment document, the learner is required to cover and keep the script neat and clean. The teacher is required to provide guidance in this respect.

Apart from the learner script, no additional file or portfolio is required.

4.2 Informal or daily assessment (Assessment for Learning)

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

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

Self-assessment and **peer assessment** actively involve learners in assessment. This is important as it allows learners to learn from and reflect on their own performance. The results of the informal daily assessment tasks are not formally recorded unless the teacher wishes to do so. In such instances, a simple checklist may be used to record this assessment. However, teachers may use the learners' performance in these assessment tasks to provide verbal or written feedback to learners, the school management team and parents. This is particularly important if barriers to learning or poor levels of participation are encountered. The results of daily assessment tasks **are not taken** into account for promotion and certification purposes.

The following outline provides teachers with informal programmes for assessment that can be followed in order to achieve effective curriculum delivery.

Informal assessment tasks do not contribute towards promotion and progression of the learner. Its sole intention is the development of knowledge and skills in preparation of formal assessment.

ASSESSMENT TASKS	TERM 1	TERM 2	TERM 3	TERM 4
Tests (class, theory and revision tests)	1	1	1	Consolidation
Assignment	1	1	1	0
Class work / case studies / work sheets	Weekly	Weekly	Weekly	Consolidation
Homework (theory and practical)	Weekly	Weekly	Weekly	Consolidation
Workshop / practical	Weekly	Weekly	Weekly	0

Evidence of informal assessment will be found in the learner's script. The nature of these tasks is described under assessment for learning.

4.3 Formal Assessment (Assessment of Learning)

4.3.1 Formal assessment requirements

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 proper standards are maintained.

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

PROGRAMME OF ASSESSMENT		
School Based Assessment SBA	Practical Assessment Task PAT	November Examination
25%	25%	50%

The formal assessment requirements for Mechanical Technology are as follows:

- School Based Assessment (SBA): SBA which is written at the end of term 1, 2 and 3, shows the learner's progress throughout the year and accounts for 25% of the learner's promotion mark,

- In Grades 10 and 11 all SBA is set and moderated internally.

- In Grade 12 the formal assessment (25%) is internally set and marked but externally moderated.

- **Practical Assessment Task (PAT):** PAT accounts for the skills the learner has mastered. This is assessed at intervals and requires the learner to engage in multiple practical sessions. During these weekly sessions, skills such as simulation, experimentation, hand skills, tool skills, machine skills and workshop practice are honed and perfected to the point where the learner may engage in the tasks set out for that particular term. The PAT accounts for 25% of the learner's promotion mark.

- In Grades 10-11 the Practical Assessment Task is set and marked internally but externally moderated.

- In Grade 12 the Practical Assessment Task (25%) is externally set, internally marked and externally moderated.

- **November examination:** At the end of each academic year every learner is required to write a final examination, which is compiled in such a way that it represents the entire theoretical content covered throughout the year. The November question paper accounts for 50% of the learner's promotion mark. The end of the year written assessment (50%) for Grade 12 is externally set, marked and moderated.

Formal assessments should cater for a range of cognitive levels and abilities of learners as shown below:

Cognitive Levels	Percentage of Task
Lower order: knowledge	30%
Middle order: comprehension and application	50%
Higher order: analysis, evaluation and synthesis	20%

4.4 Projects

Learners will only do one project per subject per annum. In Mechanical Technology, the PAT will serve as the project for learners in Grades 10-12 (refer to term plans). The PAT for Grade 12 is set by the Department of Basic Education and the PAT for Grades 10-11 is set internally by the teacher.

A project (in this case the PAT) should require the learner to:

- Plan / prepare / investigate / research to solve the identified problem / task

- Perform the task / carry out instructions (according to criteria given)

- Develop the project according to the given criteria

- Allow for some innovation and creativity.

To set the project, the teacher should:

- Determine the content / skills / knowledge to be addressed

- Set clear criteria and give extensive instructions to guide the learner (the learner should know exactly what to do and what is expected)

- Keep the scope manageable

- Determine which resources will be required to complete the project and ensure that learners have access to these resources
- Determine the time frame / duration / due date
- Determine mark distribution and compile an assessment tool.

4.5 Programme of Assessment

4.5.1 The Programme of Assessment is designed to spread formal assessment tasks in all subjects in a school throughout a term. Without this programme, tests and tasks are crowded into the last few weeks of the term creating unfair pressure on the learners.

The following is the Programme of Assessment for Grade 10-11

GRADE 10-11 ASSESSMENT REQUIREMENTS							
ASSESSMENT TASKS	**TERM 1**	**TERM 2**	**TERM 3**	**TERM 4**	**% OF FINAL PROMOTION MARK**		**MARK Weighting**
Tests	1		1		10	25 in total	250 total converted to mark out of **100**
Mid-year examination		1			15		
Practical Assessment Task	☑	☑	☑		25		250 total converted to mark out of **100**
End-of-year examination				1	50		**200**
TOTAL - **PROMOTION MARK**							**400**

The table below shows the compilation of the school based assessment mark:

Description	Time Frame	Weighting of final mark	Mark Allocation
Control test 1	**Term 1** January - April	5%	50
Mid-year examination	**Term 2** May - June	15%	150
Control test 2	Term 3 July - October	5%	50
Total		**25%**	**250**

The following is the Programme of Assessment for Grade 12:

GRADE 12 ASSESSMENT REQUIREMENTS							
ASSESSMENT TASKS	**TERM 1**	**TERM 2**	**TERM 3**	**TERM 4**	**% OF FINAL PROMOTION MARK**		**MARK Weighting**
Tests	1				5	25 in total	450 total converted to mark out of **100**
Mid-year and trial examination		1	1		20		
Practical Assessment Task (PAT)	☑	☑	☑		25		250 total converted to mark out of **100**
End-of-year examination				1	50		**200**
TOTAL - PROMOTION MARK							**400**

The table below shows the compilation of the school based assessment mark:

Description	Time Frame	Weighting of final 25%	Marks
Control test	Term 1	5%	50
May examination	Term 2	10%	200
Trial examination	Term 3	10%	200
Total		**25%**	**450**

4.5.2 Tests

- A test for formal assessment should not comprise of a series of small tests, but should cover a substantial amount of content and the duration should be at least 60 minutes.
- Each test and examination must cater for a range of cognitive levels.
- The forms of assessment used should be age and development level appropriate. The design of these tasks should cover the content of the subject and include a variety of tasks designed to achieve the objectives of the subject.

4.5.3 Examinations

- For Grades 10, 11 and 12, the three-hour end-of-year examination in Mechanical Technology (200 marks) comprises 50% of a learner's total mark. All question papers set by the teacher throughout the year, including the November paper must be scrutinized by the head of department at the school and approved by the Mechanical Technology facilitator for the district. This is done to ensure that the prescribed weightings are adhered to by the teacher.
- In the Grade 12 examination only Grade 12 content will be assessed. However, prior knowledge from Grades 10-11 may be necessary to interpret and answer some of the questions.

Grades 10, 11 and 12 Examination paper

Question	Content covered	Marks
1	Multiple-choice questions	20
2	Safety	10
3	Tools and equipment	12
4	Materials	13
5	Terminology (manufacturing process)	30
6	Joining methods	25
7	Forces	30
8	Maintenance	15
9	Systems and control	25
10	Engines, pumps and turbines	20
	TOTAL	**200**

4.6 Recording

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.

Teachers will record actual marks against the tasks by using a record sheet and also report in percentages against the subject on the learner's report cards.

4.7 Reporting

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 which 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. The following rating scale will apply for reports:

- In order for the school to report back to the parents on the progression of the learner from term to term, regular feedback is given in the form of report cards. When compiling term marks it is proposed that teachers make use of the SBA and PAT marks to show how the learner is progressing.

- The weighting of the term mark should be 50% for the SBA and 50% for the PAT mark. The term mark is however not used for the final promotion of the learner. At the end of the year the SBA, PAT and examination marks are used in the prescribed manner to calculate the promotion mark.

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: The seven point scale should have clear descriptors that give detailed information for each level.

4.8 Moderation of assessment

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

4.8.1 PAT moderation

Moderation of each term's PAT phases should start as early as the following term i.e. phase1 & 2 should be moderated as soon as the second term starts. The final phase (phase 4) project of PAT should be moderated upon completion.

The moderation process is as follows:

- During moderation learners can be selected at random to demonstrate the different PAT skills. All phases will be moderated.
- Learners being moderated will have access to their completed tasks during moderation and may refer to the phases they completed earlier in the year.
- Learners may not ask assistance from other learners during moderation.
- All projects must be on display for the moderator.
- The moderator will select at random no less than two projects (not simulations), which learners will have to explain (how the project was manufactured).
- Where required, the moderator should be able to call on the learner to explain the function, principles of operation and also request the learner to exhibit the skills acquired through the completion of the PAT
- Upon completion the moderator will, if needed, adjust the marks of the group up or downwards, depending on the decision reached as a result of moderation.
- Normal examination protocols for appeals will be adhered to if a dispute arises from adjustments made.

4.8.2 SBA moderation

Moderation of written tests and examinations shall be conducted by the subject facilitator / or a peer teacher. Grade 10 and 11 tasks are internally moderated except for the PAT that is externally moderated. The subject advisor must moderate a sample of these tasks during s school visit, to verify the standard of the internal moderation. Moderation of written tests constitutes a re-mark of the learners work to ensure assessment by the teacher is correct.

Grade 12 tasks should be moderated by the provincial subject advisor. This process will be managed by the provincial education department.

School-based moderation requires the HOD to check/ control the following:

(a) Learner compliance

- Work done by learners comply with the following requirements:
  - Date
  - Topic
  - Homework assignments reflecting a textbook page and exercise reference
  - Learner scripts are required to show scrutiny and interaction from the teacher in red pen.
  - All teacher actions/interventions in the script must be dated
  - Learners are required to mark all self-assessments in pencil and all corrections to be shown in pencil.

(b) Safety

- Learners are required to dress appropriately when entering the workshop.
- Personal safety should be adhered to
- Learner conduct in the workshop must be orderly and appropriate
- Learners are required to enact safety drills, practise safe operating procedures, perform housekeeping tasks and assist in workshop preventative maintenance such as cleaning, painting, sanding, etc.

(c) Practical Assessment Tasks/Session in the workshop

- Learners are required to actively engage in practical assessment tasks, assignments, simulations and experiments
- Learners who are un-cooperative will receive de-merits or a zero mark allocation for that particular section of work
- Learners who act unsafely in a workshop placing other learners in danger, will be removed from the workshop and will have to perform additional tasks / engage in corrective behaviour tasks to show improvement in safety awareness and skill. This will be done outside of normal contact time.

(d) Teacher compliance

- Preparation done by teacher includes:
  - Keeping to pace setters / work schedule
  - Work schedule dates are planned and achieved dates are indicated
  - Lesson plans for each topic
  - Lesson plans and dates in learners' books are aligned.
  - Worksheets /tasks /homework assignments in lesson planning aligns with learners' books.
  - Work is done every day in the learners' books.
  - Workbooks are regularly checked and dated by the teacher.
  - Tests have memorandums before the test is written
  - Examinations and major tests are moderated by a peer teacher / facilitator from district.

(e) Workshop management

- Storeroom is indexed, neat and clean
- Inventory is kept up to date every 6 months
- Workshop is clean and neat
- Preventative maintenance schedule is drawn up
- Workshop budget is prepared and ready.
- Procurement schedule for PAT and consumable items are kept up to date
- Replacement of old equipment is planned and rolled out.
- OHS Act adhered to at all times

(f) Classroom management

- Classroom is neat and clean
- Posters and exhibits are evident
- Pin boards are neatly populated
- Teacher workstation / desk is neat and clean
- Filing is neat and tidy.

4.9 Practical Assessment Task (PAT)

The Department of Basic Education issues a PAT guideline for Grade 12 every year. The format of the Grade 12 PAT guideline is duplicated for Grades 10-11.

As part of the PAT the teacher will choose one of three scenarios. These scenarios are set in the following contexts:

- Manufacturing (Terminology)
- Maintenance (Automotive)
- Joining (Welding)

In all grades each learner must do a Practical Assessment Task for the year

- **Grades 10-11**: Teachers will set and assess the Practical Assessment Task and it will be moderated externally by the subject specialists.
- **Grade 12:** The practical assessment tasks for Grade 12 will be assessed by the teacher and will be externally moderated by the provincial subject specialists.
- The date for the external moderation will be decided by the province in which the school is situated.
- The provincial education departments or schools may not change or use the task of the previous year.
- Providing the resources for the Practical Assessment Task is the responsibility of the school and schools should ensure that adequate time and funding is allocated for the completion of the Practical Assessment Task.

Practical sessions should be scheduled in such a way that learners have enough time to practise skills needed for the completion of the PAT. Weekly practice sessions are needed for the learner to hone the needed skills. A guideline of 1½ hours out of 4 hours per week (5 day cycle) is given for Grades 10-12.

NB The completed PAT project will be made up from different phases and tasks.

Practical sessions should be scheduled in such a way that learners have enough time to practise skills needed for the completion of the PAT. Weekly practice sessions are needed for the learner to hone the needed skills. A guideline of 2 hours per week is given for Grade 10-11.

In cases where the Grades 10-11 PAT tasks and topics are set by the teacher internally, the head of department at the school and Mechanical Technology district subject facilitator are required to approve each task before it is implemented in the workshop.

Provinces may opt to develop PAT guidelines for Grades 10-11 to ensure a unified curriculum approach. These guidelines may however not contradict the design principles outlined in the Grade 12 PAT.

The compilation of the PAT Grade 10 to 12 mark is detailed in the table below:

Description	Time Frame	Weighting of Final 25%	Marks
• **Phase 1 Terminology/ Manufacturing** • **Plan and prepare for PAT phase 4 task**	January - March	5%	50
• **Phase 2 Joining** • **PAT final task phase 4 under construction**	April - June	5%	50
• **Phase 3 Maintenance/ Experimentation/ Simulation task** • **Completion of phase 4**	July - September	5%	50
• **Phase 4 Final Product** • **Moderation of PAT**	July - September	10%	100
• **Total**		**25%**	**250**

Although the final PAT product only needs to be completed in the third term, learners should start working on phase 4 from the first term in order to avoid running out of time to complete the PAT.

4.10 Progression/promotion

A learner needs to achieve at least 30% (120) of the final mark to pass Mechanical Technology.

4.11 General

This document should be read in conjunction with:

4.11.1 *National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R-12;* and

4.11.2 The policy document, *National Protocol for Assessment Grades R-12.*