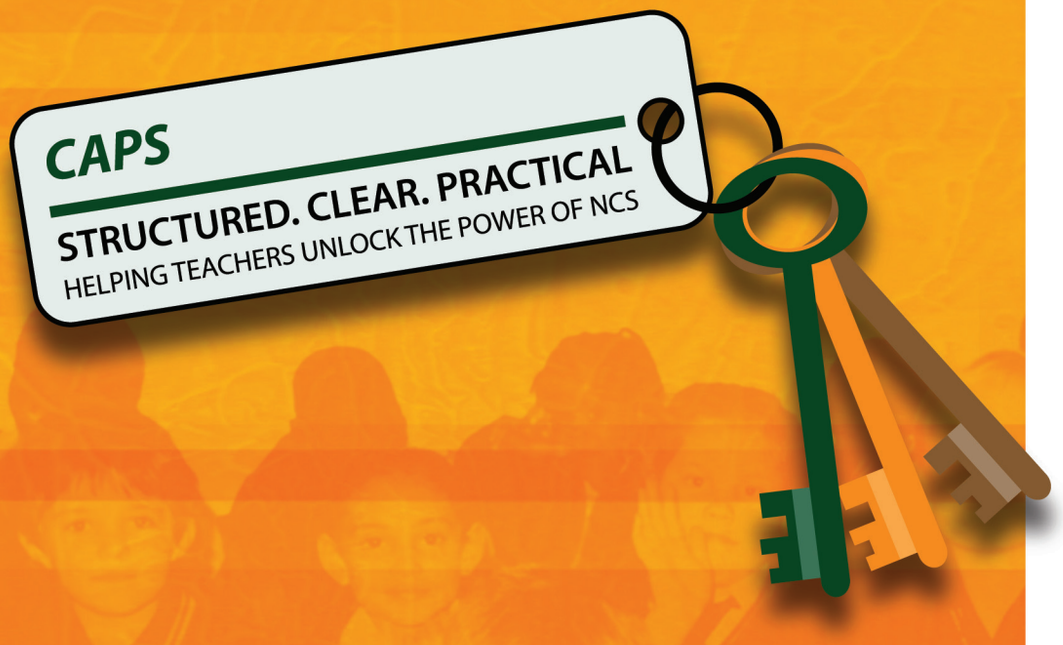
ELECTRICAL TECHNOLOGY

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

ELECTRICAL 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

CONTENTS

SECTION 1

INTRODUCTION TO THE CURRICULUM AND ASSESSMENT POLICY STATEMENTS FOR ELECTRICAL 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	**6**	**6**	**7**
• Beginning Knowledge	(1)	(1)	(2)
• Creative Arts	(2)	(2)	(2)
• Physical Education	(2)	(2)	(2)
• Personal and Social Well-being	(1)	(1)	(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	**4**
• Creative Arts	(1,5)
• Physical Education	(1)
• Personal and Social Well-being	(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

2. ELECTRICAL TECHNOLOGY

2.1 What is Electrical Technology?

Electrical Technology focuses on the understanding and application of electrical and electronic principles. The subject focuses on three main areas of specialisation namely

- Electrical
- Electronics
- Digital Systems

2.2 Specific aims

Electrical Technology as a whole aims to equip the learner with a firm foundation in electronic and electrical principles which has been translated from a knowledge base into practical skills by the end of Grade 12.

Through the integrated completion of theoretical work, practical assessment tasks (PAT) and simulations the following skills are developed:

- safe work practices
- good housekeeping
- first aid practices
- interpreting circuit diagrams
- sourcing components
- constructing circuits
- installation, testing and troubleshooting of circuits
- taking measurements
- workshop practice.

Knowledge of subject principles combined with applied electrical skills equips the electrical Technology learner with a unique set of skills, placing her/him apart from other learners and in a category much desired by industry, tertiary institutions and entrepreneurs. Learners with electrical Technology markedly fare better, during the first two years at tertiary level when studying engineering, than learners without this background, giving them the advantage when studying engineering. The need for skilled workers in South Africa has been outlined numerous times in national strategies such as the National Skills Fund (NSF), ASGISA and more.

The aim is to develop the skills levels of learners from Grade 10-12 to such an extent that they are able to enter a career pathway as soon as possible. Despite portability issues into NCV courses, learners with electrical Technology are able to enter the world of work as an apprentice or enter into a learnership following matriculation.

2.3 Requirements for the subject Electrical Technology

1. The learner, as the main stakeholder in the subject, should have access to the following minimum required items:

    - A textbook and script
    - Access to a variety of electrical and electronic magazines and reference resources
    - Drawing equipment
    - Calculator
    - Measuring equipment and tools
    - Consumable items for electrical Technology
    - Access to a computer with simulation and CAD software is strongly recommended.

2. The school should subscribe to at least one or two electrical and electronic 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.

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

4. 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 industry continuously incorporating 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 in the context and content of the subject.

5. Schools offering Electrical Technology must have a well-equipped workshop for learners to complete the Practical Assessment Tasks. The classroom/workshop needs to be secured. Enough storage space should be available to store and lock all resources. Resources to offer Electrical 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.

6. Subject advisers must provide regular support to teachers.

2.4 Career Opportunities in Electrical Technology

Electrical Technology unlocks a world of potential opportunities to any learner taking the subject. Owing to the nature of electrical Technology, it is easy and relatively cheap to setup and operate an electrical/electronic/digital workshop at home for the purpose of starting a business or to practise a hobby for personal gain.

Learners that opt for careers not related to the subject will have sufficient knowledge and skills at the end of Grade 12 to continue experimenting for the purpose of self-tuition and the practice of electrical technique.

Learners taking Electrical Technology will opt for one of the following study opportunities:

- Apprenticeship to become an artisan
- Study at a FET college in a vocational career pathway
- Enter higher education at a University of Technology or any academic University
- Enter the world of work as an entrepreneur or working with an entrepreneur
- Enter higher education to study technical education in order to become a technical teacher.

Career and life experience opportunities that exist for learners with a foundation in Electrical Technology include:

- Electrical fitter
- Electrical or electronic engineer
- Electrical draughtsperson
- Electrical or electronic technician
- Electrical or electronic technologist
- Digital / software engineer
- Academic in the field of Electrical Technology
- Electronic mechanic
- Auto-electrician
- Electrician
- Radio technician
- Cell phone technician
- Communications technician
- PLC programming expert
- Electronics programming engineer
- Computer technician

- Robotics engineer
- Mechatronics technician
- Installation electrician
- Radio amateur
- Electronic hobbyist
- Radio control enthusiast
- Production manager

SECTION 3

3.1 Content Outline for Electrical Technology

Listed below are the topics per grade with a short explanation of the focus. Note that some topics are continued from Grade 10 to 12, showing progression and increasing in complexity from year to year, whilst other topics cease at some stage. This is not due to its importance diminishing, but rather due to the integration thereof.

Grade 10 Topics	Grade 11 Topics	Grade 12 Topics
Occupational Health and Safety Responsibilities, Workshop Rules & Procedures	**Occupational Health and Safety** Introducing the OHS Act , housekeeping & personal safety	**Occupational Health and Safety** The consequences of the OHS act, risk assessment, human rights in the workplace, workethics and emergencies
Tools and measuring instruments Tools and how to use it	**Tools and measuring instruments** Measuring instruments and how to use it	
Electric Circuits Draw single-phase circuits with reference to distribution and switching circuits	**Single Phase AC Generation** How electricity is generated.	**Three Phase AC Generation** Power in three phase systems, measurement and calculations
Magnetism Principles of Magnetism and the relevant Laws.	**Single-phase Transformers** Induction, the operation of transformers and types of transformers	**Three Phase Transformers** Principles of opration, calculations and application.
	Single Phase Motors The Universal Motor, spitphase motor and its application	**Three Phase Motors & Starters** Principle of operation, Testing and commisioning and starters
Principles of electricity Introduction of electricity as the core of the subject	**RLC** The effect of AC on Series RLC Circuit	**RLC** The effect of AC on Series and parallel RLC Circuits
Protective devices Fuses and Fuse types, MCB's and eathleakage protection	**Protective devices** The Direct Online Starter and its application	
Electronic Components Basic electronic components and how it operates.	**Semi Conductor Devices** The diode, transistor, thiristor, DIAC and TRIAC and it's application	
Power Sources Basic power sources such as the battery and how it operates.	**Power Supplies** Principle of operation of linear power supplies, series and shunt using regulation.	
	Amplifiers Principle of operation and application of transistor amplifiers.	**Amplifiers** Principle of operation and application of operational amplifiers.
Logic Boolean Logic and basic logic gates with its application	**Logic** Intermediate logic principles, using logic gates to express Boolean equations and solve simple problems.	**Logic** Introduction of programmable logic control, application of Boolean Expressions and combinational logic networks
Communications Basic communication principles and modulation	**Communications** Radio communications, antennas, modes of modulation, transmitters and receivers.	

3.2 Content Outline per Term

GRADE 10 TERM 1

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)

Week	Topic	Content
1 Week (4 Hours)	**Occupational Health and Safety**	Responsibilities General Workshop Rules • Housekeeping • Unsafe Acts and • Unsafe Conditions • Walkways, Store Areas, Other designated areas • Colour Codes Emergency Procedures • Position of the main switch • Evacuation Procedures • Principles of fire fighting • Basic First Aid Basic First Aid - • What to do in case of electrical Shock • What to do when someone is bleeding
1 Week (4 Hours)	**Tools and measuring instruments.**	Identification of parts and functions including care, maintenance and safe use: • Screwdrivers (Flat and Phillips) • Files (Flat, Square, Round, Triangular and Half round) • Side Cutter • Long Nose Pliers • Combination Pliers • Wire Stripper • Utility Knife • Soldering Iron • Solder Sucker • Electric Hand Drill • Hack Saw (Junior Hack Saw) • Breadboard
1 Week (4 Hours)		Skills(Skills are developed throughout the year during practical sessions): • Safe use of Tools • Correct use of Tools. • Introductory Soldering / De-soldering Skills • Introductory Printed Circuit Board Manufacturing Skills Cleaning and tidying the workshop after practical (Housekeeping)

Week	Topic	Content
1 Week (4 Hours)	**Tools and measuring instruments.**	Safe Use and Care of Instruments: • Continuity Tester • Analog Multimeter • Digital Multimeter • Megger / Insulation Tester
1 Week (4 Hours)	**Basic Principles of electricity**	Atom Theory Theory of current flow. (Electron flow vs. Conventional Current Flow) Ohm's law: $V=IR(\Omega)$ Verify Ohm's law with calculations (Pay attention to prefixes and unit conversions) Series circuit as voltage divider - Kirchoff's Voltage Divider: $V_T=V_1 + V_2... + V_N(V)$
1 Week (4 Hours)		Parallel circuit as a current divider - Kirchoff's Current Divider (combination circuits with calculations): $I_T = I_1 + I_2... + I_N(A)$
1 Week (4 Hours)		Power Power Calculations: $P=VI(W)$ & Related Formulae Combination circuits. (4 Components) Specific resistance. (No Calculations) Negative and Positive Temperature coefficient. (No Calculations)
1 Week (4 Hours)	**Power Sources.**	• Different electrical energy sources • Primary Cells vs. Secondary Cells • Lead Acid Battery • Lithium Ion (Li-Ion) or Lithium Polymer (Li-Po) Battery • Solar Cell (Symbol, Principle of operation, composition)
1 Week (4 Hours)		• Capacity and Power (VA) Rating • Internal Resistance Electromagnetic force (EMF)
1 Week (4 Hours)		• Potential Difference (PD) • Basic Power Supply from Mains (Block Diagram)
	Tests	All topics covered in 1st Term included in test PAT: Simulations 1 and 2 completed. PAT Project under construction

GRADE 10 TERM 2

Week	Topic	Content
1 Week (4 Hours)	**Electronic Components**	Composition / Construction, symbols and values (coding) of: • Resistor • Thermistor • LDR • Incandescent Lamp Practical Session: Identify/test/measure different electronic components
1 Week (4 Hours)		• The Capacitor: - Basic principles of electrostatic charge - Capacitance - Practical: Calculation in Series and Parallel (Maximum 4 components) o $\frac{1}{C_{series}} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots + \frac{1}{C_N}$ *(Farad)* O $C_{parallel} = C_1 + C_2 \ldots + C_N$ *(Farad)* Practical: Calculations of Charge: $Q=CV$
1 Week (4 Hours)		• Charging rates and time constant including curves and calculations - t = RC (Seconds) - T = 5RC (Seconds) • Application of capacitors in DC (Examples of smoothing circuit and RC Time constant) Practical Session: Charging Characteristics of the Capacitor
1 Week (4 Hours)		Composition / Construction, symbols and values (coding) of: • Diode • Zener Diode • LED • The Transistor Practical Session: Test Components using Multimeter
1 Week (4 Hours)	**Electric Circuits**	Electrical Energy distribution - Generation to Consumer Order of Connection from Supplier to Consumer Domestic Installations
1 Week (4 Hours)		Practical Simulations of Switching Circuits: • Series Lamps, Parallel Lamps • SPST • SPDT • One way Switching • Two way Switching • Intermediate Switching
1 Week (4 Hours)		• Three Heat Switching • Five Heat Switching • Simmerstat
	Midyear Exams	All topics from term 1 to term 2 covered in Midyear Examination PAT simulations 3 and 4 completed. PAT circuit construction completed PAT enclosure under construction

GRADE 10 TERM 3

Week	Topic	Content
1 Week (4 Hours)	**Protective Devices.**	Current / Voltage operated devices. Advantages and Disadvantages, Uses and Applications of: • Fast blow and slow blow fuses
1 Week (4 Hours)		• Miniature circuit breakers (Thermal type and electromagnetic type) for domestic installations • Earth leakage devices (core type) Practical: Test Fuses using Multimeter.
1 Week (4 Hours)	**Principles of magnetism**	Composition / Construction, symbols and values (coding) of the Inductor: • Define magnetism e.g. natural, electro-magnetism. • Oersted's Experiment (Screw Driver Rule)
1 Week (4 Hours)		• Faraday's law. • Lenz's law.
1 Week (4 Hours)		• Self and Mutual inductance. • Flemings Left Hand Motor Rule • Flemings Right Hand Generator Rule Practical: Conduct Oersted's Experiment
1 Week (4 Hours)		Types of Inductors and inductor cores. • Calculations in Series and Parallel (Maximum 4 Components) • $L_{series} = L_1 + L_2 \ldots + L_N$ *(Henry)* • $\frac{1}{L_{parallel}} = \frac{1}{L_1} + \frac{1}{L_2} + \ldots + \frac{1}{L_N}$ *(Henry)* Principle of operation and application of magnetism e.g. • Relays / solenoids • Single phase transformers • DC motor Practical: Wire a circuit including a relay/solenoid/DC Motor/DC Transformer
1 Week (4 Hours)	**Logic**	Digital and Analogue (Explain the Difference) The use of number systems in digital electronics. • Decimal to Binary • Binary to Decimal • Addition and Subtraction of Binary (Test in Decimal)
1 Week (4 Hours)		Truth Table & Boolean Expression Basic 2 input logic functions of: • NOT • AND • NAND (Combination of AND / NOT) Practical: Simulation of logic circuits using switches/relays & diode logic
1 Week (4 Hours)		Truth Table & Boolean Expression Basic 2 input logic functions of: • OR • NOR (Combination of OR and NOT) • IEC Symbols (Show American Symbols also)
1 Week (4 Hours)		• Equivalent circuits using switches to simulate gates • Diode Logic Practical: Simulation of logic circuits using switches/relays & diode logic
	Test	All topics in the term covered in the test. PAT completed and ready for moderation

GRADE 10 TERM 4

Week	Topic	Content
1 Week (4 Hours)	**Logic**	Truth Table & Boolean Expression Basic 2 input logic functions of Combinational Circuits • AND/OR/NOT/NOR/NAND Practical: Simulation of combinational logic circuits using switches/relays & diode logic
1 Week (4 Hours)	**Communication Systems.**	Introduction to Communications Systems • Purpose of Communications Systems Types of Communications systems (What is it?) • Commercial Broadcasting (SABC, FM Radio and DSTV etc) • Commercial Communications (Telephone Systems, Security Companies, Air Traffic Control, Cell Phones etc) • Community Communications (Disaster Management, Emergency Services and Amateur Radio, research etc)
1 Week (4 Hours)		Radio Wave Propagation • Ground Wave Propagation • Sky wave Propagation • Line of Sight Propagation • The Radio Antenna
1 Week (4 Hours)		Principles of Modulation • Tuned Circuits • The Oscillator • What is Modulation Types of Modulation • FM - Waveforms and Block Diagrams Only • AM - Waveforms and Block Diagrams Only Practical: Simulate an oscillator and display wave on oscilloscope
1 Week (4 Hours)		Block Diagram & Operation • CW (Morse Code) Transmitter Block Diagram • Regenerative Receiver Block Diagram Practical: Construction of a Simple Radio Receiver / Transmitter
	Examination	All topics of the year covered in the examination paper PAT moderation completed

GRADE 11 TERM 1

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)

Week	Topic	Content
1 Week (4 Hours)	**OHS Act**	• Safety and OHS Act • Ergonomics • Housekeeping Principles • Signs in the workshop - Information Signs - Safety Signs - Prohibition Signs • Designated Areas • Personal Safety - Eye Protection - Cover alls / Overalls - Hearing Protection - Protective gear for machinery Practical: Identification of safety signs and safety gear
1 Week (4 Hours)	**Tools and measuring instruments**	• Digital Multimeter, Insulation Tester, Function Generator and Oscilloscope - Parts and its function - Principle of operation - Application - Care - Maintenance Practical: Basic use of the oscilloscope to display waveforms taken from the function generator.
1 Week (4 Hours)		• Tools - Crimping Tool (Ferrules, Lugs & Plugs) - Bending Spring (PVC Conduit) - Re-Visit safe use of hand tools - Introduce safe use of power tools (Drill, grinder, jigsaw) Skills (Skills are developed throughout the year during practical sessions): • Safe use of tools • Correct use of tools • Intermediate Soldering / De-soldering Skills (Using a solder wick) • Intermediate Printed Circuit Board Manufacturing Skills (Design & Make) • Cleaning and tidying the workshop after practical (Housekeeping) • Keeping the storeroom neat and tidy Practical: Practice of safe housekeeping practices and methods
1 Week (4 Hours)	**Single-phase AC generation.**	Difference between direct current and alternating current. Generation of a single-phase supply by rotating a conductor loop through a two-pole magnetic field. (Including conversion of a rotating conductor into a Sine wave) Calculation of: • Field Strength (H) • Flux (Φ) & Flux Density (B)

Week	Topic	Content
1 Week (4 Hours)		• The Sine Wave - Instantaneous value o $e = E_M Sin\theta (Volts)$ - Maximum value o $E_M = 2\pi BAnN\ (Volts)$ - RMS Value (No Mid-ordinate Rule) o $V_{RMS} = V_M \times 0.707 (Volts)$ - Average Value over half cycle (No Mid-ordinate Rule) o $V_{AVERAGE} = V_M \times 0.637 (Volts)$ Practical: Rotate magnetic field through a coil and display on Oscilloscope
1 Week (4 Hours)		The effect and calculation of: • Magnetic Field Strengths and flux density (B) • Pole Pairs (P) • Number of windings (n) • Area of the coil $(A = lb\ (M^2))$ • Frequency of rotation $(F = \frac{1}{T}\ (Hertz))$ • Lamination of the core
1 Week (4 Hours)	**Single-phase transformers.**	Magnetic Induction $(e = -L \times \frac{d_i}{d_t}\ (Volts))$ Lenz's Law - Introductory revision of Grade 10 Magneto Motive Force $(H = \frac{IN}{l}\ (Amps/meter))$ Mutual inductance (Concept only, No Calculations)
1 Week (4 Hours)		Function and operation of transformers Practical: Wiring of single phase transformer to mains supply Losses in Transformers (No Calculations) Advantages and Disadvantages Construction and symbols of transformer and core types
1 Week (4 Hours)		Application of transformer types including: • Ideal transformer • Auto transformer • Centre Tap Transformer • Voltage instrument transformers. • Current instrument transformers (The Clamp meter) Practical: Wiring of CT and VT to mains supply with instruments
1 Week (4 Hours)		Ratings and calculations on full load transformers. • VA Ratings - $S = V \times I\ (VA)$ • Power Calculations - $P = V \times I \times Cos\theta (Wats)$ - $P_R = V \times I \times Sin\theta (VA_R)$ • Ratio Calculations - $\frac{V_1}{V_2} = \frac{N_1}{N_2} \quad \frac{I_1}{I_2}$ • Primary and Secondary Voltage / Current • 100 % Efficiency ONLY Practical: Measure Primary and Secondary Voltage and Current of transformer connected to a load
	Test	All topics covered in 1st Term included in test PAT: Simulations 1 and 2 completed. PAT Project under construction

GRADE 11 TERM 2

Week	Topic	Content
1 Week (4 Hours)	**Protective devices.**	Principle of operation of: • Over current and under-voltage protection. • Re-settable over current protection (Motor protection) • The Zero Volt Coil / No-Volt Coil (Operator protection)
1 Week (4 Hours)		**The Direct Online Starter / Contactor** • Identification, operation and purpose of: - The Contactor - Start button - Stop button - Overload Protection o Setting Over Current Protection - Wiring Diagram of the DoL - Practical Wiring of DoL Starter - Testing & Commissioning Practical: Connecting the DoL Starter to a load
1 Week (4 Hours)	**Single-phase motors.**	Operation of single- phase induction motors • **Universal Motor** • How to obtain a rotating magnetic field in single-phase motors. • Split Phase Motor • Capacitor Start Motor (CSM) - Function of components - Diagram - Reversal of direction of rotation - Practical: Testing o Visual Inspection Test o Insulation o Continuity of windings o Test earth continuity. o Mechanical Test - Practical Application & Use: Connection of a CSM) - Wire DoL to Motor - Start and Stop Motor
1 Week (4 Hours)		• Capacitor Start and Run Motor (CS&RM) - Function of components - Diagram - Reversal of direction of rotation - Practical: Testing o Visual Inspection Test o Insulation o Continuity of windings o Test earth continuity. o Mechanical Test - Application & Use (Practical connection of a CS&RM) o Wire DoL to Motor o Start and Stop Motor

Week	Topic	Content
1 Week (4 Hours)	**RLC**	Effect of alternating current on R, L and C components in series circuits only. Emphasis will be on circuits containing ONE resistor, ONE capacitor and ONE inductor. Inductive Reactance: $X_L = 2\pi FL(\Omega)$ Capacitive Reactance: $X_C = \frac{1}{2\pi FC}(\Omega)$ Impedance: $Z = \sqrt{R^2 + (X_L \simeq X_C)^2}(\Omega)$
1 Week (4 Hours)		Power: $P = V \times I \times Cos\theta$ (Watts) Phase Angle: $\theta = Cos^{-1}\frac{R}{Z}$ (Degrees) Power Factor: $Cos\ \theta = \frac{R}{Z}$ Phasor and wave representation. Resonance with its characteristic curves: $F_O = \frac{1}{2\pi\sqrt{L \times C}}$
1 Week (4 Hours)		Calculations. • Series combination circuits containing one resistor, one capacitor and one inductor • Frequency changes • Phasor and wave representation • Resonance • Phasor Diagram
	Midyear Examination	All topics from term 1 to term 2 covered in Midyear Examination PAT simulations 3 and 4 completed. PAT circuit construction completed PAT enclosure under construction

GRADE 11 TERM 3

Week	Topic	Content
1 Week (4 Hours)	**Semi-conductor devices.**	Construction, symbols, characteristic curves ,values (coding), principle of operation and composition of: • PN Diode • Zener Diode Calculation of: • Diode Load line
1 Week (4 Hours)		Construction, symbols, characteristic curves ,values (coding), principle of operation and composition of: • NPN Transistor • PNP Transistor
1 Week (4 Hours)		Construction, symbols, characteristic curves ,values (coding), principle of operation and composition of: • Thyristor - SCR / Thyristor/ DIAC / TRIAC
1 Week (4 Hours)		Application / Use of: • Transistor as switch - Circuit Diagram - Construction on Breadboard - Measurement of input and output voltage in On and Off Stage • SCR/Thyristor/TRIAC with DIAC practical application - Circuit Diagram - Construction on Breadboard - Measurement of input and output voltage in On and Off Stage
1 Week (4 Hours)	**Power supplies.**	Principles and operation of DC power supplies: • Transformation • Rectification (half wave and full wave using bridge rectifier and centre tap transformer) - Waveforms - Breadboard Construction - Representation of Waves on Oscilloscope
1 Week (4 Hours)		Principles and operation of DC power supplies: • Filtering(Ripple Factor, C, LC, and π) and - Block Diagram - Waveforms - Breadboard Construction - Representation of Waves on Oscilloscope Calculations: • Ripple Factor • Percentage Calculations
1 Week (4 Hours)		Principles and operation of DC power supplies: • Regulating (Series & Shunt Regulation using Zener Diode and transistor) - Circuit Diagram - Waveforms - Breadboard Construction - Representation of Waves on Oscilloscope Calculations: • Zener Calculations

Week	Topic	Content
1 Week (4 Hours)	**Amplifiers.**	What is an Amplifier, Amplification Types / Types of Amplifier (Class A, B, AB and C) using transistors? Principle of operation of a transistor amplifier • Connection • Characteristics • Circuit diagrams • Input and output signals of: - Common Base(no biasing) - Common Collector (no biasing) - Common Emitter (with different types of biasing)
1 Week (4 Hours)		Types of biasing applied to the Common Emitter Amplifier. • Fixed Base Biasing - Circuit Diagram - Advantages & Disadvantages • Collector feedback biasing - Circuit Diagram - Advantages & Disadvantages • Voltage divider Biasing - Circuit Diagram - Advantages & Disadvantages Calculation of: • Transistor DC Load Line (Common Emitter amplifier with fixed current biasing) • Reference to regions of operation as well as Vcc and Vce
1 Week (4 Hours)		The interpretation of a load line in conjunction with an AC signal (Active region) to determine the values of the base and collector current using emitter output curve to derive amplification classes. Influence of DC biasing on the load line and Q point. Negative Feedback (Basic Introduction only - no circuits) • What is feedback? (Applications & purpose) • Advantages and disadvantages PRACTICAL: Class A Audio Amplifier (Construction, Testing & Measurement) • Common Emitter • Input Waveform • Output Waveform • Breadboard Construction • Representation of Waves on Oscilloscope
	Test	All topics in the term covered in the test. PAT completed and ready for moderation

GRADE 11 TERM 4

Week	Topic	Content
1 Week (4 Hours)	**Logic**	Identify and interpret logic gates and symbols. Apply logic gates with a maximum of three inputs. • NOT - Truth Table - Boolean Expression • AND / NAND - Truth Table - Boolean Expression • OR / NOR - Truth Table - Boolean Expression • XOR/XNOR - Truth Table - Boolean Expression
1 Week (4 Hours)		Apply Commutative and Distributive Laws. Product of Sums / Sum of Products (POS/SOP) Apply Theory into Practical Circuits
1 Week (4 Hours)		De Morgan's Theorem Combinational / Complex Circuits (Half Adder, Three Input Alarm etc.)
1 Week (4 Hours)		NAND / NOR Gate Combinational / Equivalent Circuits Simplify logic equations by using Boolean expressions / Drawing and constructing / simulating logic circuits.
1 Week (4 Hours)	**Communications**	Radio Communication Systems (Concepts Only) • Point to point • Repeater Systems • Cellular Systems Antennas (Basic Theory / RF Wave Shape) • Relation between Frequency and Wavelength • Omni Directional Antennas (Car Antenna) • Half Wave Dipole (Alarm Company Antenna) • Quarter Wave Antenna (Short Vertical Antenna) • Directional Antennas - the Yagi-Uda Array (TV Antenna)
1 Week (4 Hours)		Principle of operation of different types of Modulation (How modulation is obtained) • Purpose of a Carrier wave • Purpose of Modulation / Demodulation • How to obtain Frequency Modulation • How to obtain Amplitude Modulation • How to obtain Single Side Band Suppressed Carrier Modulation The Transmitter • AM Transmitter Block Diagram with explanation of parts • FM Transmitter Block Diagram with explanation of parts The Receiver • The AM Receiver Block Diagram with explanation of parts • The FM Receiver Block Diagram using a Foster Sealy Discriminator with explanation of parts
	Examination	All topics of the year covered in the examination paper PAT moderation completed

GRADE 12 TERM 1

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)

Week	Topic	Content
1 Week (4 Hours)	**Occupational Health and Safety**	Ocupational Health and Safety Act. • Unsafe Actions • Dangerous Practices • Unsafe Conditions • Risk Analysis • Human rights in the workplace • Work Ethics • Medical emergencies
1 Week (4 Hours)	**Three Phase AC Generation**	Principles of 3-Phase AC Generation • **Advantages and disadvantages** of single- vs. three-phase systems • Wave form of single- and three-phase systems • Phasor diagram of single- and three-phase systems • 3-phase systems; Star vs. Delta (Delta vs. Star) - Schematic (sketch without indication of components) - Diagrammatic (sketch with components) representations of three-phase systems. • Only balanced loads
1 Week (4 Hours)		Power in three-phase systems and calculations. • Active: $P = \sqrt{3} \times V \times I \times Cos\theta$ *(Watt)* • Reactive Power: $P_R = \sqrt{3} \times V \times I \times Sin\theta$ (VA_R) • Apparent Power: $S = \sqrt{3} \times V \times I$ *(VA)* • Introduction to star and delta calculations with reference to basic line /phase values: - $V_L = \sqrt{3} \times V_P$(Star) - $V_L = V_P$(Delta) - $I_L = \sqrt{3} \times I_P$(Delta) - $I_L = \sqrt{3} \times V_P$(Star) • Losses • Efficiency (For Calculations: η=100%) • Only concept of power factor correction - no calculations for exam purposes. Purpose of: • wattmeter, • kWh meter • Power Factor meter when connecting instruments in circuits. • Two and three wattmeter connections and calculations (All diagrams and circuits must be given, and then questions asked referring to diagrams/ circuits) • Reference kW, kVA and KVAr

Week	Topic	Content
1 Week (4 Hours)	**Three Phase Transformers**	Principle of operation and connections of three phase transformers. Concept and understanding of losses. Three phase transformers compared to Single phase Types of 3Φ Transformers - Basic types of construction Transformers(delta/star, star/delta, delta/delta, star/star) Calculations: (Efficiency at 100%) • Ratio • Line and Phase Current, Voltage and Power • Power Factor • Power • Load including losses and efficiency.
1 Week (4 Hours)		Construction of Transformers Application of Transformers Cooling Methods Safety Protection

Week	Topic	Content
1 Week (4 Hours)	**Three Phase Motors & Starters**	Principle of Operation • Three phase squirrel cage induction motor - Construction - Advantages - Applications - Calculations on slip, power, efficiency. - $Synchronous\ Speed = \frac{f}{p}\ (rpm)$ - $\frac{Synchronous\ Speed - Rotor\ Speed}{Synchronous\ Speed}$ - $\frac{P_{IN} - Losses}{P_{IN}}$ - Electrical and mechanical • Faultfinding / Troubleshooting • Motor testing Direct On Line Starter with overload • Function of components on diagrams • Principle of Operation • Diagram • Wiring on a panel • Start & Stop
1 Week (4 Hours)		Forward and Reverse Starter with overload • Function of components on diagrams • Principle of Operation • Diagram • Wiring on a panel • Start & Stop
1 Week (4 Hours)		Automatic Star Delta Starter with overload (Not Manual) • Function of components on diagrams • Principle of Operation • Diagram • Wiring on a panel • Start & Stop
1 Week (4 Hours)		Sequence Motor Control Starter with overload (Without Timer): Practical • Function of components on diagrams • Principle of Operation • Diagram • Wiring on a panel • Start & Stop
1 Week (4 Hours)		Sequence Motor Control Starter with overload (With Timer): Practical • Function of components on diagrams • Principle of Operation • Diagram • Wiring on a panel • Start & Stop
	Test	All topics covered in 1st Term included in test PAT: Simulations 1 and 2 completed. PAT Project under construction

GRADE 12 TERM 2

Week	Topic	Content
1 Week (4 Hours)	**RLC**	Effect of alternating current on R, L and C components in series and parallel circuits. • Inductive Reactance • Capacitive Reactance • Impedance • Power • Phase Angle and Power Factor
1 Week (4 Hours)		• Phasor and wave representation. • Resonance with its characteristic curves. • Q-Factor • Calculations. Practical: Simulate RLC circuit and display waveform on oscilloscope
1 Week (4 Hours)	**Logic**	Introduction to the Programmable Logic Control Device and History of the PLC as a rationale for using a PLC (Hard Wiring vs. Soft Wiring, Advantages of using PLC's) The programmed scan cycle of a PLC (Input, Process, Output) Introduction to Ladder Logic
1 Week (4 Hours)		Conversion of simplified Boolean expressions (Using Karnaugh maps / POS / SOP / Boolean Algebra) to Ladder Logic and labelling of symbols. Combination Logic Networks
1 Week (4 Hours)		Conversion of Hard Wired Schematics (Control Circuits) to Ladder Logic and labelling of symbols. Problem Solving using PLC applications Safety and PLC Devices • Inputs to a PLC (Digital) • Outputs on a PLC (Transistor / Relay) • Contactors / relays • Counters related to PLC. (Up Counter) • Latching Concepts (Interlocking / retaining circuits) • Timers (On Delay / Off Delay) • Markers / Flags (Memory elements) Practical: Program PLC with functions to include all devices listed
1 Week (4 Hours)		Practical: Programming of PLC's as Motor Starter Controllers (Practical) • Direct On Line Starter • Forward and Reverse Starter • Automatic Star Delta Starter
1 Week (4 Hours)		• Sequence Motor Control Starter(Without Timer) • Sequence Motor Control Starter(With Timer)
	Tests and Examinations	Consolidation of Term 1 & 2 All topics from term 1 to term 2 covered in Midyear Examination PAT simulations 3 and 4 completed. PAT circuit construction completed PAT enclosure under construction

GRADE 12 TERM 3

Week	Topic	Content
1 Week (4 Hours)	**Amplifiers**	Characteristics of an ideal Op-amp. The differential amplifier as the basis of operational amplifiers. Principle of operation of negative / positive feedback in an op amp circuit. All circuits given using a 741 Operational Amplifier
1 Week (4 Hours)		Application of the Op-amp including, input and output waveforms of: • Comparator - Circuit Diagram - Waveform - Construction on Breadboard - Representing of waveform on Oscilloscope - Measurement of Output waveform Practical: Simulate Comparator and display waveform on Oscilloscope
1 Week (4 Hours)		• Inverting- and non-inverting amplifier circuits - Circuit Diagram - Waveform - Construction on Breadboard - Representing of waveform on Oscilloscope - Measurement of Output waveform Practical: Simulate amplifier circuits and show waveform on oscilloscope Calculations on: Inverting / non inverting amplifier calculations
1 Week (4 Hours)		Application of the Op-amp including, input and output waveforms of: • Summing amplifier - Circuit Diagram - Waveform - Construction on Breadboard - Representing of waveform on Oscilloscope - Measurement of Output waveform • Differentiator and Integrator - Circuit Diagram - Waveform - Construction on Breadboard - Representing of waveform on Oscilloscope - Measurement of Output waveform Calculations on: • Summing amplifier Practical: Simulate amplifier circuits and show waveform on oscilloscope

Week	Topic	Content
1 Week (4 Hours)	**Amplifiers**	Application of the Op-amp including, input and output waveforms of: • Multi-vibrator (Bi, Mono and A-stable) - Circuit Diagram - Waveform - Construction on Breadboard - Representing of waveform on Oscilloscope - Measurement of Output waveform • Schmidt Trigger - Circuit Diagram - Waveform - Construction on Breadboard - Representing of waveform on Oscilloscope - Measurement of Output waveform Calculations on: • RC Time Constant (Multi-vibrators) Practical: Simulate circuits and show waveform on oscilloscope
1 Week (4 Hours)		Application of the Op-amp including, input and output waveforms of: • Hartley / Collpitts Oscillator • RC Phase Shift Oscillator Calculations on: • Oscillation Frequency Practical: Simulate circuits and show waveform on oscilloscope
	Preparatory Examination, PAT & SBA Moderation	Consolidation Term 1, 2 & 3 Preparatory Examination to include all topics covered PAT / SBA completed and ready for moderation

GRADE 12 TERM 4

WEEK	Topic	DETAILED CONTENT- Grade 12
1 Week (4 Hours)	**Consolidation Term 1**	• Occupational Health and Safety • Three Phase AC Generation
1 Week (4 Hours)	**Consolidation Term 1**	• Three Phase Transformers • Three Phase Motors & Starters
1 Week (4 Hours)	**Consolidation Term 2**	• Effect of AC on series an parallel RL and C • Logic
1 Week (4 Hours)	**Consolidation Term 3**	• Amplifiers
	National Senior Certificate	

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 Electrical 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 Electrical 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 (PAT) 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 (PAT) 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 Electrical 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 Electrical 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.

Grade 10 Examination paper - November

Question	Topic	Weighting	Marks
1	Occupational health and safety	5%	10
2	Tools and measuring instruments	5%	10
3	Basic principles of electricity Electric circuits Magnetism	15% 5% 10%	60
4	Power sources	10%	20
5	Electronic components Protective devices	10% 5%	30
6	Logic	25%	50
7	Communications	10%	20
	Total	100%	200

Grade 11 Examination paper - November

Question	Topic	Weighting	Marks
1	Occupational health and safety Tools and measuring instruments	5%	10
2	Single phase AC generation Single-phase transformers	15% 10%	50
3	Single-phase motors Protective devices	15%	30
4	Semi-conductor devices Power supplies Amplifiers	10% 5% 10%	50
5	RLC	10%	20
6	Logic	10%	20
7	Communications	10%	20
	Total	100%	200

Grade 12 Examination paper - November

Question	Topic	Percentage	Marks for NSC
1	Occupational health and safety	5%	10
2	Three-phase AC generation	10%	20
3	Three-phase transformers	10%	20
4	Three-phase motors and starters	20%	40
5	RLC	10%	20
6	Logic	20%	40
7	Amplifiers	25%	50
	Total	100%	200
	Final Weighting	50% of final mark	

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 simulations can start as early as the following term i.e. simulation 1 & 2 can be moderated as soon as the second term starts. The project will only be moderated upon completion.

The moderation process is as follows:

- During moderation learners are selected at random to demonstrate the different PAT simulations. All four simulations will be moderated.
- Learners being moderated will have access to their completed simulations during moderation and may refer to the simulations 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 simulations.
- 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 by the HOD requires the HOD to check the following:

- 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 pe.
    - 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.
  - 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.
  - 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.
- 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.

- 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.
- 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:

- Electrical
- Electronics
- Digital

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 per week is given for Grades 10-12.

Each scenario consists of a number of tasks which will combine to form the PAT mark. Owing to the nature of a PAT, the scenario chosen by the teacher for the school, may not necessarily tie up with the topic being taught at a particular time.

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 simulations and topics are set by the teacher internally, the head of department at the school and Electrical 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 guideline.

The compilation of the PAT mark is detailed in the table below:

Description	Time Frame	Weighting of Final 25%	Marks
Simulation/Experiment 1	January - March	5%	50
Simulation/Experiment 2	January - March	5%	50
Simulation/Experiment 3	April - June	5%	50
Simulation/Experiment 4	April - June	5%	50
Final Product	July - September	5%	50
Total		**25%**	**250**

Although the final PAT product only needs to be completed in the third term, learners should start working on the project 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 Electrical 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.*