education

Department:
Education
REPUBLIC OF SOUTH AFRICA

National Curriculum Statement
Grades 10–12
(General)

ELECTRICAL TECHNOLOGY

Department of Education

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HOW TO USE THIS BOOK

This document is a policy document divided into four chapters. It is important for the reader to read and integrate information from the different sections in the document. The content of each chapter is described below.

Chapter 1 – Introducing the National Curriculum Statement

This chapter describes the principles and the design features of the National Curriculum Statement Grade 10–12 (General). It provides an introduction to the curriculum for the reader.

Chapter 2 – Introducing the Subject

This chapter describes the definition, purpose, scope, career links and Learning Outcomes of the subject. It provides an orientation to the Subject Statement.

Chapter 3 – Learning Outcomes, Assessment Standards, Content and Contexts

This chapter contains the Assessment Standards for each Learning Outcome for the subject. The Assessment Standards are arranged to assist the reader to see the intended progression from Grade 10 to Grade 12.

Chapter 4 – Assessment

This chapter deals with the generic approach to assessment being suggested by the National Curriculum Statement. At the end of the chapter is a table of subject-specific competence descriptions. Codes, scales and competence descriptions are provided for each grade. The competence descriptions are arranged to demonstrate progression from Grade 10 to Grade 12.

Symbols

The following are used to identify Learning Outcomes, Assessment Standards, grades, codes, scales, competence description, and content and context.

 = Learning Outcome

 = Scale

 = Assessment Standard

 = Competence Description

 = Grade

 = Content and Contexts

 = Code

CONTENTS

ACRONYMS

AC	Alternating Current
AIDS	Acquired Immune Deficiency Syndrome
AM	Amplitude Modulation
AS	Assessment Standard
CASS	Continuous Assessment
DC	Direct Current
FET	Further Education and Training
GET	General Education and Training
HE	Higher Education
HIV	Human Immunodeficiency Virus
IEC	International Electrotechnical Commission
IKS	Indigenous Knowledge Systems
ISO	International Organisation for Standardisation
LO	Learning Outcome
LPG	Learning Programme Guideline
NCS	National Curriculum Statement
NQF	National Qualifications Framework
OBE	Outcomes-Based Education
OHS	Occupational Health and Safety
PLC	Programmable Logic Controller
SANS	South African National Standards
SANS 0142	Standard for the Wiring of Premises
SI	Système International
SKVA	Skills, Knowledge, Values and Attitudes

CHAPTER 1

INTRODUCING THE NATIONAL CURRICULUM STATEMENT

The adoption of the Constitution of the Republic of South Africa (Act 108 of 1996) provided a basis for curriculum transformation and development in South Africa. The Preamble 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 foundation 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.

The Constitution further states that "everyone has the right … to further education which the State, through reasonable measures, must make progressively available and accessible ".

The National Curriculum Statement Grades 10–12 (General) lays a foundation for the achievement of these goals by stipulating Learning Outcomes and Assessment Standards, and by spelling out the key principles and values that underpin the curriculum.

PRINCIPLES

The National Curriculum Statement Grades 10–12 (General) is based on the following principles:

- social transformation;
- outcomes-based education;
- high knowledge and high skills;
- integration and applied competence;
- progression;
- articulation and portability;
- human rights, inclusivity, environmental and social justice;
- valuing indigenous knowledge systems; and
- credibility, quality and efficiency.

Social transformation

The Constitution of the Republic of South Africa forms the basis for social transformation in our post-apartheid society. The imperative to transform South African society by making use of various transformative tools stems from a need to address the legacy of apartheid in all areas of human activity and in education in particular. Social transformation in education is aimed at ensuring that the educational imbalances of the past are redressed, and that equal educational opportunities are provided for all sections of our population. If social transformation is to be achieved, all South Africans have to be educationally affirmed through the recognition of their potential and the removal of artificial barriers to the attainment of qualifications.

Outcomes-based education

Outcomes-based education (OBE) forms the foundation for the curriculum in South Africa. It strives to enable all learners to reach their maximum learning potential by setting the Learning Outcomes to be achieved by the end of the education process. OBE encourages a learner-centred and activity-based approach to education. The National Curriculum Statement builds its Learning Outcomes for Grades 10–12 on the Critical and Developmental Outcomes that were inspired by the Constitution and developed through a democratic process.

The Critical Outcomes require learners to be able to:

- identify and solve problems and make decisions using critical and creative thinking;
- work effectively with others as members of a team, group, organisation and community;
- 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.

The Developmental Outcomes require learners to be able to:

- reflect on and explore a variety of strategies to learn more effectively;
- participate as responsible citizens in the life of local, national and global communities;
- be culturally and aesthetically sensitive across a range of social contexts;
- explore education and career opportunities; and
- develop entrepreneurial opportunities.

High knowledge and high skills

The National Curriculum Statement Grades 10–12 (General) aims to develop a high level of knowledge and skills in learners. It sets up high expectations of what all South African learners can achieve. Social justice requires the empowerment of those sections of the population previously disempowered by the lack of knowledge and skills. The National Curriculum Statement specifies the minimum standards of knowledge and skills to be achieved at each grade and sets high, achievable standards in all subjects.

Integration and applied competence

Integration is achieved within and across subjects and fields of learning. The integration of knowledge and skills across subjects and terrains of practice is crucial for achieving applied competence as defined in the National Qualifications Framework. Applied competence aims at integrating three discrete competences – namely, practical, foundational and reflective competences. In adopting such integration and applied competence, the National Curriculum Statement Grades 10–12 (General) seek to promote an integrated learning of theory, practice and reflection.

Progression

Progression refers to the process of developing more advanced and complex knowledge and skills. The Subject Statements show progression from one grade to another. Each Learning Outcome is followed by an explicit statement of what level of performance is expected for the outcome. Assessment Standards are arranged in a format that shows an increased level of expected performance per grade. The content and context of each grade will also show progression from simple to complex.

Articulation and portability

Articulation refers to the relationship between qualifications in different National Qualifications Framework levels or bands in ways that promote access from one qualification to another. This is especially important for qualifications falling within the same learning pathway. Given that the Further Education and Training band is nested between the General Education and Training and the Higher Education bands, it is vital that the Further Education and Training Certificate (General) articulates with the General Education and Training Certificate and with qualifications in similar learning pathways of Higher Education. In order to achieve this articulation, the development of each Subject Statement included a close scrutiny of the exit level expectations in the General Education and Training Learning Areas, and of the learning assumed to be in place at the entrance levels of cognate disciplines in Higher Education.

Portability refers to the extent to which parts of a qualification (subjects and/or unit standards) are transferable to another qualification in a different learning pathway of the same National Qualifications Framework band. For purposes of enhancing the portability of subjects obtained in Grades 10–12, various mechanisms have been explored, for example, regarding a subject as a 20-credit unit standard. Subjects contained in the National Curriculum Statement Grades 10–12 (General) compare with appropriate unit standards registered on the National Qualifications Framework.

Human rights, inclusivity, environmental and social justice

The National Curriculum Statement Grades 10–12 (General) seeks to promote human rights, inclusivity, environmental and social justice. All newly-developed Subject Statements are infused with the principles and the practices of social and environmental justice and human rights as is defined in the Constitution of the Republic of South Africa. In particular, the National Curriculum Statement Grades 10–12 (General) is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors.

The National Curriculum Statement Grades 10–12 (General) adopts an inclusive approach by specifying minimum requirements for all learners. It acknowledges that all learners should be able to develop to their full potential provided they receive the necessary support. The intellectual, social, emotional, spiritual and physical needs of learners will be addressed through the design and development of appropriate Learning Programmes and through the use of appropriate assessment instruments.

Valuing Indigenous Knowledge Systems

In the 1960's, the theory of multi-intelligences forced educationists to recognise that there were many ways of processing information to make sense of the world, and that, if one were to define intelligence anew, one would have to take these different approaches into account. Up until then the Western world had only valued logical, mathematical and specific linguistic abilities, and rated people as 'intelligent' only if they were adept in these ways. Now people recognise the wide diversity of knowledge systems through which people make sense of and attach meaning to the world in which they live. Indigenous knowledge systems in the South African context refer to a body of knowledge embedded in African philosophical thinking and social practices that have evolved over thousands of years. The National Curriculum Statement Grades 10–12 (General) has infused indigenous knowledge systems into the Subject Statements. It acknowledges the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution. As many different perspectives as possible have been included to assist problem solving in all fields.

Credibility, quality and efficiency

The National Curriculum Statement Grades 10–12 (General) aims to achieve credibility through pursuing a transformational agenda and through providing an education that is comparable in quality, breadth and depth to those of other countries. Quality assurance is to be regulated by the requirements of the South African Qualifications Authority Act (Act 58 of 1995), the Education and Training Quality Assurance Regulations, and the General and Further Education and Training Quality Assurance Act (Act 58 of 2001).

THE KIND OF LEARNER THAT IS ENVISAGED

Of vital importance to our development as people are the values that give meaning to our personal spiritual and intellectual journeys. *The Manifesto on Values, Education and Democracy* (Department of Education, 2001: 9–10) states the following about education and values:

" Values and morality give meaning to our individual and social relationships. They are the common currencies that help make life more meaningful than might otherwise have been. An education system does not exist to simply serve a market, important as that may be for economic growth and material prosperity. Its primary purpose must be to enrich the individual and, by extension, the broader society."

The kind of learner that is envisaged is one who will be imbued with the values and act in the interests of a society based on respect for democracy, equality, human dignity and social justice as promoted in the Constitution.

The learner emerging from the Further Education and Training band must also demonstrate achievement of the Critical and Developmental Outcomes listed earlier in this document. Subjects in the Fundamental Learning Component collectively promote the achievement of the Critical and Developmental Outcomes, while specific subjects in the Core and Elective Components individually promote the achievement of particular Critical and Developmental Outcomes.

In addition to the above, learners emerging from the Further Education and Training band must:

- have access to, and succeed in, life-long education and training of good quality;
- demonstrate an ability to think logically and analytically, as well as holistically and laterally; and
- be able to transfer skills from familiar to unfamiliar situations.

THE KIND OF TEACHER THAT IS ENVISAGED

All teachers are key the contributors to the transformation process of education in South Africa. The National Curriculum Statement Grades 10–12 (General) visualises teachers who are qualified, competent, dedicated and caring. They will be able to fulfil the various roles outlined in the Norms and Standards for Teachers. These include being mediators of learning, interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors, and subject specialists.

STRUCTURE AND DESIGN FEATURES

Structure of the National Curriculum Statement

The National Curriculum Statement Grades 10–12 (General) consists of an Overview Document, the Qualifications and Assessment Policy Framework, and the Subject Statements.

The subjects in the National Curriculum Statement Grades 10–12 (General) are categorised into Learning Fields.

What is a Learning Field?

A Learning Field is a category that serves as a home for cognate subjects, and that facilitates the formulation of rules of combination for the Further Education and Training Certificate (General). The demarcations of the Learning Fields for Grades 10–12 took cognisance of articulation with the General Education and Training and Higher Education bands, as well as with classification schemes in other countries.

Although, in the development of all the National Curriculum Statement, Grades 10–12 (General) has taken the twelve National Qualifications Framework organising fields as its point of departure, it should be emphasised that those organising fields are not necessarily Learning Fields or "knowledge" fields, but rather are linked to occupational categories.

The following subject groupings were demarcated into Learning Fields to help with learner subject combinations:

- Agricultural Sciences;
- Arts and Culture;
- Business, Commerce and Management Studies;
- Languages;
- Manufacturing, Engineering and Technology;
- Human and Social Studies;
- Physical, Mathematical, Computer and Life Sciences; and
- Services.

What is a subject?

Historically, a subject has been defined as a specific body of academic knowledge. This understanding of a subject laid emphasis on knowledge at the expense of skills, values and attitudes. Subjects were viewed by some as static and unchanging, with rigid boundaries. Very often, subjects mainly emphasised Western contributions to knowledge.

In an outcomes-based curriculum like the National Curriculum Statement Grades 10–12 (General), subject boundaries are blurred. Knowledge integrates theory, skills and values. Subjects are viewed as dynamic, always responding to new and diverse knowledge, including knowledge that traditionally has been excluded from the formal curriculum.

A subject in an outcomes-based curriculum is broadly defined by Learning Outcomes, and not only by its body of content. In the South African context, the Learning Outcomes should, by design, lead to the achievement of the Critical and Developmental Outcomes. Learning Outcomes are defined in broad terms and are flexible, making allowances for the inclusion of local inputs.

What is a Learning Outcome?

A Learning Outcome is a statement of an intended result of learning and teaching. It describes skills, knowledge, values and attitudes (SKVA) that learners should acquire by the end of the Further Education and Training band.

What is an Assessment Standard?

Assessment Standards are criteria that collectively describe what a learner should know and be able to demonstrate at a specific grade. They embody the skills, knowledge, values and attitudes (SKVA) the required to achieve the Learning Outcomes. Assessment Standards within each Learning Outcome collectively show how conceptual progression occurs from grade to grade.

Contents of Subject Statements in the Manufacturing, Engineering and Technology Field

Each draft Subject Statement consists of four chapters:

- *Chapter 1, Introducing the National Curriculum Statement:* This is a generic chapter that introduces the National Curriculum Statement Grades 10–12 (General).
- *Chapter 2, Introducing the Subject:* This chapter introduces the key features of the subject. It consists of a definition of the subject, its purpose, scope, educational and career links, and Learning Outcomes.
- *Chapter 3, Learning Outcomes, Assessment Standards:* This chapter contains Learning Outcomes with their associated Assessment Standards.
- *Chapter 4, Assessment:* This chapter outlines principles for assessment and makes suggestions for recording and reporting on assessment. It also lists subject-specific competence descriptions.
- *Glossary:* Where appropriately, a list of selected general and subject-specific terms are briefly defined.

LEARNING PROGRAMME GUIDELINES

A Learning Programme specifies the scope of learning and assessment for the three grades in the Further Education and Training band. It is the plan that ensures that learners achieve the Learning Outcomes as prescribed by the Assessment Standards for a particular grade. The Learning Programme Guidelines (LPGs) assist teachers and other Learning Programme developers to plan and design quality learning, teaching and assessment programmes.

CHAPTER 2

ELECTRICAL TECHNOLOGY

DEFINITION

Electrical Technology focuses on the understanding and application of electrical and electronic principles. The subject deals with the technological process inherent in the production of products, services and systems to improve quality of life.

PURPOSE

Electrical Technology will expose learners to skills, knowledge, values and attitudes (SKVA) that will enable them to:

- understand the social contribution of Electrical Technology with regard to economic growth, entrepreneurship and sustainability and as a tool for change to improve quality of life and provide solutions in responsive to individual and community needs;
- identify and solve problems in the Electrical Technological environment using critical and creative thinking to, among others, develop the creative potential of learners;
- communicate effectively using verbal, written, visual and graphical communication and mathematical skills as applied to Electrical Technology;
- organise and manage activities responsibly and effectively;
- collect, analyse, organise and critically evaluate relevant information;
- use science and technology effectively and critically, showing responsibility to the environment and the rights and health of others, with particular reference to managing the impact of Electrical Technology on natural resources, cultural values and socio-economic development; and
- demonstrate an understanding of the ethical considerations, values and attitudes which relate to Electrical Technology.

Learners are prepared for career pathways and additional Education and Training opportunities by:

- applying knowledge and skills in Electrical Technology;
- developing entrepreneurial skills;
- exploring education and career opportunities;
- learning to be sensitive to the rights of others, including those with disabilities and those living with and affected by HIV/Aids; and
- adapting methodology and assessment for learners with special needs.

SCOPE

Electrical Technology affords learners the opportunity to carry out practical projects, experiments and real-life tasks using a variety of processes and skills. The subject Electrical Technology is organised to include:

- technology, society and the environment;
- technological process;
- safety and health;
- tooling and instrumentation;
- generation and application of AC and DC;
- protective and switching devices;
- electrical, electronic and logic systems; and
- power systems.

To ensure mobility between National Qualifications Framework (NQF) levels, progression to Higher Education and access to careers in Electrical Technology, the subject includes but is not limited to:

- the application of mathematical, physical, electrical and electronic principles;
- engineering and technological problem solving, design and graphics;
- the concepts of electrical, electronic and logic systems
- effective technical, supervisory and general management principles;
- language presentation skills including terminology, style, structure and graphical support; and
- knowledge of codes, practice and legislation.

EDUCATIONAL AND CAREER LINKS

In the General Education and Training band, the Technology Learning Area covers a wide range of technological areas. Technology is organised around the following Learning Outcomes:

- Technological processes and skills
- Technological knowledge and understanding
- Technology, society and environment

The Technology Learning Area encourages learners to identify, investigate, design, make, evaluate and communicate solutions. At the Further Education and Training level, learners are equipped with the basic knowledge and skills needed to ensure competence and confidence within the Electrical Technology environment.

In the Further Education and Training Band, training and practice are integrated to allow a learner the opportunity to exercise and reinforce technical skills and apply acquired knowledge to choose educational pathways at Higher Education and Training Institutions or trade, occupational and professional pathways to qualify as an:

- Electrician
- Auto-electrician
- Electrical fitter
- Electrical or electronic engineer
- Electrical draughtsperson
- Electrical or electronic technician
- Electrical or electronic technologist
- Academic in the field of Electrical Technology
- Electronic mechanic

These career pathways also offer new scope and opportunities for people with disabilities (e.g. deaf learners) to be economically independent.

LEARNING OUTCOMES

Although all Learning Outcomes are equally important, the Learning Outcomes have not been allocated equal weighting in terms of time and resources. Learning Outcomes 3 and 4 reflect knowledge, understanding and the application of knowledge and support one another. Learning Outcome 1 reflects technological, social and environmental issues and provides the context for Learning Outcome 3 and Learning Outcome 4, while Learning Outcome 2 reflects the technological process and is used as the organising concept.

Learning Outcome 1: Technology, Society and the Environment

The learner is able to demonstrate an awareness and understanding of the interrelationship between technology, society and the environment.

In this Learning Outcome, learners investigate the impact of technology on natural resources, cultural values and socio-economic development with particular reference to sustainability and indigenous knowledge systems. It also seeks to create awareness in learners about health and fair and equal access to employment and services and to prepare them for entry level employment, entrepreneurial opportunities and further studies.

Learning Outcome 2: Technological Process

The learner is able to understand and apply the technological process.

In this Learning Outcome, learners develop the skill to identify, investigate, design, make and evaluate processes and products and/or projects related to technology and to communicate their findings using appropriate terminology and a variety of communication media.

Learning Outcome 3: Knowledge and Understanding

The learner is able to demonstrate an understanding of the concepts and principles related to Electrical Technology.

In this Learning Outcome, learners acquire electrical, electronic and logic principles and concepts.

Learning Outcome 4: Application of Knowledge

The learner is able to apply principles and practices related to Electrical Technology.

In this Learning Outcome, learners demonstrate principles and practices related to electrical, electronic and logic applications.

CHAPTER 3

LEARNING OUTCOMES, ASSESSMENT STANDARDS, CONTENT AND CONTEXTS

ASSESSMENT STANDARDS

The numbering system

All Assessment Standards are numbered in the following manner:

For example 10.1.4:

- The first number refers to the grade, that is Grade 10.
- The second number refers to the Learning Outcome, that is Learning Outcome 1.
- The third number refers to the Assessment Standards, that is Assessment Standard 4.

Grade 10

Learning Outcome 1

Technology, Society and the Environment

The learner is able to demonstrate an awareness and understanding of the interrelationship between Technology, society and the environment.

Assessment Standards

We know this when the learner is able to:

- 10.1.1
  Describe the interrelationship between technology, society and the environment.
- 10.1.2
  Describe human rights issues.
- 10.1.3
  Describe, explain and respond to basic medical emergencies in context, taking cognisance of health issues such as HIV/Aids.
- 10.1.4
  Identify indigenous knowledge systems of different cultures.
- 10.1.5
  Describe entrepreneurship and its influence on society and environment.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.1.1
  Discuss and evaluate the interrelationship between technology, society and the environment.
- 11.1.2
  Consider human rights issues and discuss fair and equal employment practices.
- 11.1.3
  Describe, explain and respond to medical emergencies in context, taking cognisance of health issues such as HIV/Aids.
- 11.1.4
  Compare how different cultures solved technological problems.
- 11.1.5
  Discuss the competencies required by entrepreneurs.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.1.1
  Predict the impact of future developments in technology on society and environment.
- 12.1.2
  Respect human rights and analyse issues relating to employment equity.
- 12.1.3
  Describe, explain and respond to medical emergencies in context, taking cognisance of health issues such as HIV/Aids.
- 12.1.4
  Analyse how solutions to technological problems in different cultures are combined into an optimum solution.
- 12.1.5
  Identify and investigate possible entrepreneurial opportunities.

Grade 10

Learning Outcome 2

Technological Process

The learner is able to understand and apply the technological process.

Note: There is no progression in the Assessment Standards across the grades as Learning Outcome 2 is a process. The progression across the grades is reflected in the increasing degree of complexity of the content.

Assessment Standards

We know this when the learner is able to:

- 10.2.1
  Identify, investigate, define and analyse problems in a given real-life situation.
- 10.2.2
  Generate and/or design possible solutions for problems.
- 10.2.3
  Make or improve products according to the selected design.
- 10.2.4
  Evaluate the final product against the initial design.
- 10.2.5
  Present assignments by means of a variety of communication media.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.2.1
  Identify, investigate, define, and analyse problems in a given real-life situation.
- 11.2.2
  Generate and/or design possible solutions for problems.
- 11.2.3
  Make or improve products according to the selected design.
- 11.2.4
  Evaluate the product against the initial design.
- 11.2.5
  Present assignments by means of a variety of communication media.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.2.1
  Identify, investigate, define and analyse problems in a given real-life situation.
- 12.2.2
  Generate and/or design possible solutions for problems.
- 12.2.3
  Make or improve products according to the selected design.
- 12.2.4
  Evaluate the product against the initial design.
- 12.2.5
  Present assignments by means of a variety of communication media.

Grade 10

Learning Outcome 3

Knowledge and Understanding

The learner is able to demonstrate an understanding of the concepts and principles related to Electrical Technology.

Assessment Standards

We know this when the learner is able to:

- 10.3.1
  Demonstrate an understanding of the Occupational Health and Safety (OHS) Act where applicable.
- 10.3.2
  Describe the use and care of tools and measuring instruments.
- 10.3.3
  Describe the principles of magnetism.
- 10.3.4
  Describe the principles of electricity.
- 10.3.5
  Describe the principles of electrostatics.
- 10.3.6
  Identify and describe the characteristics of electronic components.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.3.1
  Apply the Occupational Health and Safety (OHS) Act and regulations where applicable.
- 11.3.2
  Explain the use and care of instruments.
- 11.3.3
  Explain the principles of single-phase AC generation.
- 11.3.4
  Explain the principles and effect of AC on resistor, inductor and capacitor components and determine the effect on a combination of series circuits.
- 11.3.6
  Explain the operating principles, characteristics curves and use of semi-conductor devices.
- 11.3.7
  Explain the operation of an amplifier circuit.
- 11.3.8
  Describe the principle of operation and use of single-phase transformers.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.3.1
  Apply the Occupational Health and Safety (OHS) Act and regulations where applicable.
- 12.3.3
  Explain three-phase AC generation.
- 12.3.4
  Determine the effect of AC on series and parallel resistor, inductor and capacitor component combination circuits.
- 12.3.6
  Explain the operating principles of switching and control circuits.
- 12.3.7
  Analyse the output of amplifiers, taking characteristics and feedback into account.
- 12.3.8
  Explain the operation and use of three-phase transformers.

Grade 10

Learning Outcome 3 (continued)

Knowledge and Understanding

The learner is able to demonstrate an understanding of the concepts and principles related to Electrical Technology.

Assessment Standards

We know this when the learner is able to:

- 10.3.9
  Describe the principles of operation and use of power sources.
- 10.3.10
  Describe basic logic concepts.
- 10.3.11
  Describe and compare different types of protective devices.
- 10.3.12
  Draw single-phase circuits.
- 10.3.13
  Describe electronic communication systems.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.3.9
  Describe the principles of operation and use of power supplies.
- 11.3.10
  Combine logic concepts to form logic systems.
- 11.3.11
  Explain the operating principles of different protective devices.
- 11.3.12
  Explain the operating principles and application of single-phase motors.
- 11.3.13
  Explain the operating principles of modulation and demodulation with reference to communication systems.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.3.10
  Combine logic concepts as an introduction to programmable control.
- 12.3.12
  Explain the operating principles and application of three-phase motors and control.

Grade 10

Learning Outcome 4

Application of Knowledge

The learner is able to apply principles and practices related to Electrical Technology.

Note: The Assessment Standards of Learning Outcome 3 must be applied in the following context as reflected in Learning Outcome 4:

- Safety and instruments
- Electrical applications
- Electronics
- Digital electronics applications

Assessment Standards

We know this when the learner is able to:

- 10.4.1
  Safety and instruments
  Identify unsafe conditions and acts and apply tools and instruments correctly.

- 10.4.2
  Electrical applications
  Construct and comprehend single-phase circuits.

- 10.4.3
  Electronics
  Construct and comprehend electronic circuits.

- 10.4.4
  Digital electronics
  Construct and comprehend digital circuits.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.4.1
  Safety and instruments
  Identify unsafe conditions and acts and apply tools and instruments correctly.
- 11.4.2
  Electrical applications
  Construct and apply single-phase circuits.
- 11.4.3
  Electronics
  Construct and apply electronic circuits.
- 11.4.4
  Digital electronics
  Construct and apply digital circuits.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.4.1
  Safety and instruments
  Identify unsafe conditions and acts and apply tools and instruments correctly.
- 12.4.2
  Electrical applications
  Construct and analyse single-phase and three-phase circuits.
- 12.4.3
  Electronics
  Construct and analyse electronic circuits.
- 12.4.4
  Digital electronics
  Construct and analyse programmable control circuits.

CONTENT AND CONTEXTS FOR THE ATTAINMENT OF ASSESSMENT STANDARDS

In this section, content and contexts are provided to support the attainment of the Assessment Standards. The content indicated needs to be dealt in a way that assists the learner to achieve the Learning Outcomes. Content must serve the Learning Outcomes and not be an end in itself.

The contexts suggested embed content in situations which are meaningful to the learner and so assist learning and teaching. The teacher should be aware of and use local contexts not necessarily indicated here, which could be more suited to the learners' experiences.

Content and contexts, when aligned to the attainment of the Assessment Standards, provide a framework for the development of Learning Programmes. The Electrical Technology Learning Programme Guideline (LPG) gives more detail in this respect.

The contexts and content statements are numbered in the following manner and relate to the numbering system used for the Assessment Standards:

For example 10.1.4:

- The first number refers to the grade, that is Grade 10.
- The second number refers to the Learning Outcome, which is Learning Outcome 1.
- The third number refers to the Assessment Standards, that is Assessment Standard 4.

Grade 10

Learning Outcome 1

Technology, Society and the Environment

The learner is able to demonstrate an awareness and understanding of the interrelationship between Technology, society and the environment.

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 10.1.1
  Understand environmental technology issues.
- 10.1.2
  Understand human rights issues as captured in the Bill of Rights.
- 10.1.3
  Respond to basic medical emergencies in context, taking cognisance of health issues such as HIV/Aids.
- 10.1.4
  Understand indigenous knowledge systems of different cultures.
- 10.1.5
  Understand the principles of entrepreneurial activity.

Grade 11

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 11.1.1
  Describe environment technology.
- 11.1.2
  Discuss human rights issues including fairness, equality and inclusivity.
- 11.1.3
  Respond to basic medical emergencies in context, taking cognisance of health issues such as HIV/Aids.
- 11.1.4
  Compare how different cultures solved technological problems.
- 11.1.5
  Discuss entrepreneurial principles to help improve the economy.

Grade 12

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 12.1.1
  Apply the principles of conservation to environmental technology.
- 12.1.2
  Apply human rights and work ethics.
- 12.1.3
  Respond to basic medical emergencies in context, taking cognisance of health issues such as HIV/Aids.
- 12.1.4
  Analyse solutions to technological problems in different cultures.
- 12.1.5
  Investigate entrepreneurial opportunities.

Grade 10

Learning Outcome 2

Technological Process

The learner is able to understand and apply the technological process.

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 10.2.1
  Identify, investigate, research, access, process and use data to make a meaningful summary.
- 10.2.2
  Design taking cognisance of constraints, specifications and alternative solutions and substantiate choice of design.
- 10.2.3
  Make products according to the design and specify materials, tools, equipment, processes and sequence of manufacturing process.
- 10.2.4
  Evaluate and test the product to establish if it satisfies the design brief and suggest improvements.
- 10.2.5
  Choose and use appropriate technologies (e.g. computer, photocopiers, stencils, audio-visual recordings) to combine graphics and text to record and communicate the problem-solving process.

Grade 11

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 11.2.1
  Identify, investigate, research, access, process and use data to make a meaningful summary.
- 11.2.2
  Design taking cognisance of constraints, specifications and alternative solutions and substantiate choice of design.
- 11.2.3
  Make products according to the design and specify materials, tools, equipment, processes and sequence of manufacturing process.
- 11.2.4
  Evaluate and test the product to establish if it satisfies the design brief and suggest improvements.
- 11.2.5
  Choose and use appropriate technologies (e.g. computer, photocopiers, stencils, audio-visual recordings) to combine graphics and text to record and communicate the problem-solving process.

Grade 12

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 12.2.1
  Identify, investigate, research, access, process and use data to make a meaningful summary.
- 12.2.2
  Design taking cognisance of constraints, specifications and alternative solutions and substantiate choice of design.
- 12.2.3
  Make products according to the design and specify materials, tools, equipment, processes and sequence of manufacturing process.
- 12.2.4
  Evaluate and test the product to establish if it satisfies the design brief and suggest improvements.
- 12.2.5
  Choose and use appropriate technologies (e.g. computer, photocopiers, stencils, audio-visual recordings) to combine graphics and text to record and communicate the problem-1solving process.

Grade 10

Learning Outcome 3

Knowledge and Understanding

The learner is able to demonstrate an understanding of the concepts and principles related to Electrical Technology.

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 10.3.1
  Describe the Occupational Health and Safety (OHS) Act with reference to general unsafe actions, dangerous practices and unsafe conditions.

- 10.3.2
  Describe the use and care of different types of tools and measuring instruments, such as pliers, screwdrivers, multimeters and continuity or insulation testers.

- 10.3.3
  Describe the principles of electro-magnetism with reference to Faraday's law and Lenz's law and its application in a relay and DC motor.

Grade 11

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 11.3.1
  Explain the Occupational Health and Safety (OHS) Act dealing with unsafe actions, dangerous practices and unsafe conditions.

- 11.3.2
  Explain the use and care for instruments and their correct application and interpretation to ensure accurate measurements such as a multimeter, continuity or insulation tester, function generator and oscilloscope.

- 11.3.3
  Explain the principles of AC generation of a single-phase supply by a rotating conductor loop in a two-pole magnetic field.

Grade 12

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 12.3.1
  Discuss the Occupational Health and Safety (OHS) Act dealing with unsafe actions, dangerous practices and unsafe conditions.

- 12.3.3
  Explain three-phase AC generation with reference to the identification and sketching of the waveforms and phasor diagrams to indicate the difference between single and three-phase systems.Identify and explain the function of the wattmeter, kWh meter and power factor meter. Explain the concept of power and power factor correction supported by calculations.

Grade 10

Learning Outcome 3 (continued)

Knowledge and Understanding

The learner is able to demonstrate an understanding of the concepts and principles related to Electrical Technology.

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 10.3.4
  Describe the principles of electricity with reference to:
  - Atom theory
  - Ohm's law and calculations
  - Theory of current flow
  - Series circuit as voltage divider
  - Parallel circuit as a current divider
  - Combination circuits
  - Specific resistance
  - Temperature coefficient

- 10.3.5
  Describe the principles of electrostatics with reference to capacitance and electrostatic charge.

- 10.3.6
  Identify and describe the characteristics of electronic components such as:
  - Resistors
  - Light dependent resistors
  - Capacitors
  - Inductors
  - PN-diodes
  - Light emitting diodes and transformers

Grade 11

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 11.3.4
  Explain the principles and effect of AC on resistor, inductor and capacitor components with reference to:
  - Series combination circuits containing one resistor, one capacitor and one inductor
  - Frequency changes
  - Phasor and wave representation
  - Resonance
  - Calculations

- 11.3.6
  Explain the operating principles, characteristics curves and use of semi-conductor devices such as:
  - PN diodes
  - Bipolar transistors
  - Thyristors

Grade 12

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 12.3.4
  Determine the effect of AC on series and parallel resistor, inductor and capacitor component combination circuits with reference to:
  - Series combination circuits containing one resistor, one capacitor and one inductor
  - Parallel combination circuits containing one resistor, one capacitor and one inductor
  - Frequency changes
  - Phasor and wave representation
  - Resonance
  - Calculations

- 12.3.6
  Explain the operating principles of switching and control circuits such as, speed control of a universal motor and power control of an incandescent lamp.

Grade 10

Learning Outcome 3 (continued)

Knowledge and Understanding

The learner is able to demonstrate an understanding of the concepts and principles related to Electrical Technology.

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 10.3.9
  Describe the principles of operation and use of power sources like batteries and solar cells like internal resistance, capacity and VA rating.

- 10.3.10
  Describe the following logic concepts:
  - Binary number systems
  - Logic symbols
  - Logic functions: AND, OR and NOT

- 10.3.11
  Describe and compare a variety of protective devices and applications such as fuses, miniature circuit breakers and earth leakage devices.

Grade 11

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 11.3.7
  Explain the operating principles of amplifier circuits such as a NPN common emitter transistor amplifier and compare input and output signals and interpret the load line.
- 11.3.8
  Describe the operating principles and applications of single-phase power and instrument transformers. Apply the transformer equation.
- 11.3.9
  Describe the principles of operation and use of different power supplies with reference to transformation, rectification, filtering and regulation.
- 11.3.10
  Combine logic concepts and use a maximum of three input logic gates to form logic systems by applying Boolean algebra. Draw simplified logic circuit.
- 11.3.11
  Explain the operating principles of a variety of protective devices such as overcurrent and undervoltage protection.

Grade 12

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 12.3.7
  Analyse the effect on the output of amplifiers, taking characteristics and feedback into account with reference to:
  - Characteristics of an op-amp
  - Identification and explanation of the effect of feedback on amplifier
  - Calculations of oscillation frequencies
- 12.3.8
  Explain the operation and applications of three-phase transformers including calculations and the concept of losses
- 12.3.10
  Combine logic concepts as an introduction to programmable control referring to concepts such as inputs, outputs, timers, counters and timing diagrams.

Grade 10

Learning Outcome 3 (continued)

Knowledge and Understanding

The learner is able to demonstrate an understanding of the concepts and principles related to Electrical Technology.

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 10.3.12
  Draw single-phase circuits with reference to distribution and switching circuits.

- 10.3.13
  Describe electronic communication systems such as signalling with lamp or buzzer (*Morse code*) and the block diagram approach of transmitters and receivers.

Grade 11

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 11.3.12
  Explain the operating principles and application of single-phase motors such as split phase and universal complete with main and control circuits.
- 11.3.13
  Describe and understand the principles of modulation and demodulation in communication systems such as amplitude and frequency modulation and refer to medium used as carrier.

Grade 12

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 12.3.12
  Explain, with calculations, the operating principles and application of three-phase motors to include the function of motor starters and interpretation of schematic diagrams.

Grade 10

Learning Outcome 4

Application of Knowledge

The learner is able to apply principles and practices related to Electrical Technology.

Note: The Assessment Standards of Learning Outcome 3 must be applied in the following context as reflected in Learning Outcome 4:

- Safety and instruments
- Electrical applications
- Electronics
- Digital electronics applications

It is not always viable to apply the knowledge required in Learning Outcome 3 in isolation.

Example:
For single-phase circuits (*10.3.4*) a power source (*10.3.9*) is necessary. However, it is not safe to use a single-phase circuit without protective devices, thus protective devices must be added (*10.3.11*) to the circuit. In theory, the concepts can be dealt with in isolation but in practice the different elements must be combined.

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 10.4.1
  Safety and instruments
  Identify unsafe conditions and acts when doing practical work and apply tools and instruments correctly to:
  - Verify Ohm's laws
  - Verify specific resistance
  - Verify the change in resistance with reference to the change in temperature
  - Test insulation, continuity and earth continuity on portable equipment

- 10.4.2
  Electrical applications
  Construct and comprehend single-phase circuits such as single-phase switching and relay circuits, taking into account power sources and protective devices.

- 10.4.3
  Electronics
  Construct and comprehend electronic circuits such as a continuity tester by making use relevant electronic components and a power source. Convert circuit diagrams to practical applications.

Grade 11

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 11.4.1
  Safety and instruments
  Identify unsafe conditions and acts when doing practical work and apply tools and instruments correctly to:
  - Verify Kirchoff's laws in AC-and DC circuits.
  - Demonstrate the effect of single-phase AC on R, L and C components and investigate the effect of combinations of series circuits, including the effect of frequency changes
  - Test insulation, continuity and earth continuity on equipment

- 11.4.2
  Electrical applications
  Construct and apply single-phase circuits such as single-phase domestic and/or motor circuits that could include powers supplies, timers, protective devices and relay logic control circuits.

- 11.4.3
  Electronics
  Construct and apply electronic circuits such as amplifier circuits and investigate the effect of changing component values on the output.

Grade 12

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 12.4.1
  Safety and instruments
  Identify unsafe conditions and acts when doing practical work and apply tools and instruments correctly to investigate the effect of series and parallel circuits containing any combination of R, L and C components when connected to single-phase AC, including the effect that frequency changes have on the phase angle.

- 12.4.2
  Electrical applications
  Construct and apply three-phase circuits such as distribution systems that include star and delta transformers connections or relay logic control circuits that include timing devices for the control of three-phase motors with reference to sequence and star and delta starting.

- 12.4.3
  Electronics
  Construct and analyse electronic circuits such as
  - Switching circuits with thyristor
  - Amplifiers with feedback

Grade 10

Learning Outcome 4 (continued)

Application of Knowledge

The learner is able to apply principles and practices related to Electrical Technology.

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 10.4.4
  Digital electronics
  Construct and comprehend digital electronics circuits to illustrate AND, OR and NOT functions.

Grade 11

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 11.4.4
  Digital electronics
  Construct and apply digital electronics circuits such as an alarm system using combination logic circuits.

Grade 12

Assessment Standards

The attainment of the Assessment Standards is not limited to the following content and contexts statements.

- 12.4.4
  Digital electronics
  Introduce programmable control by applying the concepts of inputs-outputs, timers, counters and timing diagrams. (e.g. PLC or PICs).

CHAPTER 4

ASSESSMENT

INTRODUCTION

Assessment is a critical element of the National Curriculum Statement Grades 10–12 (General). It is a process of collecting and interpreting evidence in order to determine the learner's progress in learning and to make a judgement about a learner's performance. Evidence can be collected at different times and places, and with the use of various methods, instruments, modes and media.

To ensure that assessment results can be accessed and used for various purposes at a future date, the results have to be recorded. There are various approaches to recording learners' performances. Some of these are explored in this chapter. Others are dealt with in a more subject-specific manner in the Learning Programme Guidelines.

Many stakeholders have an interest in how learners perform in Grades 10–12. These include the learners themselves, parents, guardians, sponsors, provincial departments of education, the Department of Education, the Ministry of Education, employers, and higher education and training institutions. In order to facilitate access to learners' overall performances and to inferences on learners' competences, assessment results have to be reported. There are many ways of reporting. The Learning Programme Guidelines and the Qualification and Assessment Policy Framework discuss ways of recording and reporting on school-based and external assessment as well as giving guidance on assessment issues specific to the subject.

WHY ASSESS

Before a teacher assesses learners, it is crucial that the purposes of the assessment be clearly and unambiguously established. Understanding the purposes of assessment ensures that an appropriate match exists between the purposes and the methods of assessment. This, in turn, will help to ensure that decisions and conclusions based on the assessment are fair and appropriate for the particular purpose or purposes.

There are many reasons why learners' performance is assessed. These include monitoring progress and providing feedback, diagnosing or remediation barriers to learning, selection, guidance, supporting learning, certification and promotion.

In this curriculum, learning and assessment are very closely linked. Assessment helps learners to gauge the value of their learning. It gives them information about their own progress and enables them to take control of and to make decisions about their learning. In this sense, assessment provides information about whether teaching and learning is succeeding in getting closer to the specified Learning Outcomes. When assessment indicates lack of progress, teaching and learning plans should be changed accordingly.

TYPES OF ASSESSMENT

This section discusses the following types of assessment:

- baseline assessment;
- diagnostic assessment;
- formative assessment; and
- summative assessment.

Baseline assessment

Baseline assessment is important at the start of a grade, but can occur at the beginning of any learning cycle. It is used to establish what learners already know and can do. It helps in the planning of activities and in Learning Programme development. The recording of baseline assessment is usually informal.

Diagnostic assessment

Any assessment can be used for diagnostic purposes – that is, to discover the cause or causes of a learning barrier. Diagnostic assessment assists in deciding on support strategies or identifying the need for professional help or remediation. It acts as a checkpoint to help redefine the Learning Programme goals, or to discover what learning has not taken place so as to put intervention strategies in place.

Formative assessment

Any form of assessment that is used to give feedback to the learner is fulfilling a formative purpose. Formative assessment is a crucial element of teaching and learning. It monitors and supports the learning process. All stakeholders use this type of assessment to acquire information on the progress of learners. Constructive feedback is a vital component of assessment for formative purposes.

Summative assessment

When assessment is used to record a judgement of the competence or performance of the learner, it serves a summative purpose. Summative assessment gives a picture of a learner's competence or progress at any specific moment. It can occur at the end of a single learning activity, a unit, cycle, term, semester or year of learning. Summative assessment should be planned and a variety of assessment instruments and strategies should be used to enable learners to demonstrate competence.

WHAT ASSESSMENT SHOULD BE AND DO

Assessment should:

- be understood by the learner and by the broader public;
- be clearly focused;
- be integrated with teaching and learning;
- be based on pre-set criteria of the Assessment Standards;
- use a variety of instruments;
- use a variety of methods;
- allow for expanded opportunities for learners;
- be learner-paced and fair; and
- be flexible.

HOW TO ASSESS

Teachers' assessment of learners' performances must have a great degree of reliability. This means that teachers' judgements of learners' competences should be generalisable across different times, assessment items and markers. The judgements made through assessment should also show a great degree of validity; that is, they should be made on the aspects of learning that were assessed.

Because each assessment cannot be totally valid or reliable by itself, decisions on learner progress must be based on more than one assessment. This is the principle behind continuous assessment (CASS). Continuous assessment is a strategy that bases decisions about learning on a range of different assessment activities and events that happen at different times throughout the learning process. It involves assessment activities that are spread throughout the year, using various kinds of assessment instruments and methods such as tests, examinations, projects and assignments. Oral, written and performance assessments are included. The different pieces of evidence that learners produce as part of the continuous assessment process can be included in a portfolio. Different subjects have different requirements for what should be included in the portfolio. The Learning Programme Guidelines discuss these requirements further.

Continuous assessment is classroom-based and school-based, and focuses on the ongoing manner in which assessment is integrated into the process of teaching and learning. Teachers get to know their learners through their day-to-day teaching, through questioning, through observation, and through interacting with the learners and watching them interact with one another.

Continuous assessment should be applied both to sections of the curriculum that are best assessed through written tests and assignments and those that are best assessed through other methods, such as by performance, using practical or spoken evidence of learning.

METHODS OF ASSESSMENT

Self-assessment

All Learning Outcomes and Assessment Standards are transparent. Learners know what is expected of them. Learners can, therefore play an important part, through self-assessment, in "re-assessing" work before the teacher does the final assessment. Reflection on one's own learning is a vital component of learning.

Peer assessment

Peer assessment, using a checklist or rubric, helps both the learners whose work is being assessed and the learners who are doing the assessment. The sharing of the criteria for assessment empowers learners to evaluate their own and others' performances.

Group assessment

The ability to work effectively in groups is one of the Critical Outcomes. Assessing group work involves looking for evidence that the group of learners co-operate, assist one another, divide work, and combine individual contributions into a single composite assessable product. Group assessment looks at process as well as product. It involves assessing social skills, time management, resource management and group dynamics, as well as the output of the group.

METHODS OF COLLECTING ASSESSMENT EVIDENCE

There are various methods of collecting evidence. Some of these are discussed below.

Observation-based assessment

Observation-based assessment methods tend to be less structured and allow the development of a record of different kinds of evidence for different learners at different times. This kind of assessment is often based on tasks that require learners to interact with one another in pursuit of a common solution or product. Observation has to be intentional and should be conducted with the help of an appropriate observation instrument.

Test-based assessment

Test-based assessment is more structured, and enables teachers to gather the same evidence for all learners in the same way and at the same time. This kind of assessment creates evidence of learning that is verified by a specific score. If used correctly, tests and examinations are an important part of the curriculum because they give good evidence of what has been learned.

Task-based assessment

Task-based or performance assessment methods aim to show whether learners can apply the skills and knowledge they have learned in unfamiliar contexts or in contexts outside of the classroom. Performance assessment also covers the practical components of subjects by determining how learners put theory into practice. The criteria, standards or rules by which the task will be assessed are described in rubrics or task checklists, and help the teacher to use professional judgement to assess each learner's performance.

RECORDING AND REPORTING

Recording and reporting involves the capturing of data collected during assessment so that it can be logically analysed and published in an accurate and understandable way.

Methods of recording

There are different methods of recording. It is often difficult to separate methods of recording from methods of evaluating learners' performances.

The following are examples of different types of recording instruments:

- rating scales;
- task lists or checklists; and
- rubrics.

Each example is discussed below.

Rating scales

Rating scales are any marking system wherein a symbol (A or B) or a mark (such as 5/10 or 50%) is defined in detail to link the coded score to a description of the competences that are required to achieve that score. The detail is more important than the coded score in the process of teaching and learning, as it gives learners a much clearer idea of what has been achieved and where and why their learning has fallen short of the target. Traditional marking tended to use rating scales without the descriptive details, making it difficult to have a sense of the learners' strengths and weaknesses in terms of intended outcomes. A six-point scale is used in the National Curriculum Statement Grades 10–12 (General).

Task lists or checklists

Task lists or checklists consist of discrete statements describing the expected performance in a particular task. When a particular statement (criterion) on the checklist can be observed as having been satisfied by a learner during a performance, the statement is ticked off. All the statements that have been ticked off on the list

(as criteria that have been met) describe the learner's performance. These checklists are very useful in peer or group assessment activities.

Rubrics

Rubrics are a combination of rating codes and descriptions of standards. They consist of a hierarchy of standards with benchmarks that describe the range of acceptable performance in each code band. Rubrics require teachers to know exactly what is required by the outcome. Rubrics can be holistic, giving a global picture of the standard required, or analytic, giving a clear picture of the distinct features that make up the criteria, or can combine both. The Learning Programme Guidelines give examples of subject-specific rubrics.

To design a rubric, a teacher has to decide the following:

- Which outcomes are being targeted?
- Which Assessment Standards are targeted by the task?
- What kind of evidence should be collected?
- What are the different parts of the performance that will be assessed?
- What different assessment instruments best suit each part of the task (such as the process and the product)?
- What knowledge should be evident?
- What skills should be applied or actions taken?
- What opportunities for expressing personal opinions, values or attitudes arise in the task and which of these should be assessed and how?
- Should one rubric target all the Learning Outcomes and Assessment Standards of the task or does the task need several rubrics?
- How many rubrics are, in fact, needed for the task?

It is crucial that a teacher shares the rubric or rubrics for the task with the learners before they do the required task. The rubric focuses both the learning and the performance and becomes a powerful tool for self-assessment.

Reporting performance and achievement

Reporting performance and achievement informs all those involved with or interested in the learner's progress. Once the evidence has been collected and interpreted, teachers need to record a learner's achievements. Sufficient summative assessments need to be made so that a report can make a statement about the standard achieved by the learner.

The National Curriculum Statement Grades 10–12 (General) adopts a six-point scale of achievement. The scale is illustrated in Table 4.1.

Table 4.1 Scale of achievement for the National Curriculum Statement Grades 10–12 (General)

Rating Code	Description of Competence	Marks (%)
6	Outstanding	80–100
5	Meritorious	60–79
4	Satisfactory	50–59
3	Adequate	40–49
2	Partial	30–39
1	Inadequate	0–29

SUBJECT COMPETENCE DESCRIPTIONS

To assist with benchmarking the achievement of Learning Outcomes in Grades 10–12, subject competences have been described to distinguish the grade expectations of what learners must know and be able to achieve. Six levels of competence have been described for each subject for each grade. These descriptions will assist teachers to assess learners and place them in the correct rating. The descriptions summarise what is spelled out in detail in the Learning Outcomes and the Assessment Standards, and give the distinguishing features that fix the achievement for a particular rating. The various achievement levels and their corresponding percentage bands are illustrated in Table 4.1.

In line with the principles and practice of outcomes-based assessment, all assessment – both school-based and external – should primarily be criterion-referenced. Marks could be used in evaluating specific assessment tasks, but the tasks should be assessed against rubrics instead of simply ticking correct answers and awarding marks in terms of the number of ticks. The statements of competence for a subject describe the minimum skills, knowledge, attitudes and values that a learner should demonstrate for achievement on each level of the rating scale.

When teachers/assessors prepare an assessment task or question, they must ensure that the task or question addresses an aspect of a particular outcome. The relevant Assessment Standard or Standards must be used when creating the rubric for assessing the task or question. The descriptions clearly indicate the minimum level of attainment for each category on the rating scale.

The competence descriptions for this subject appear at the end of this chapter.

PROMOTION

Promotion at Grade 10 and Grade 11 level will be based on internal assessment only, but must be based on the same conditions as those for the Further Education and Training Certificate. The requirements, conditions, and rules of combination and condonation are spelled out in the Qualification and Assessment Policy Framework.

WHAT REPORT CARDS SHOULD LOOK LIKE

There are many ways to structure a report card, but the simpler the report card the better, providing that all important information is included. Report cards should include information about a learner's overall progress, including the following:

- the learning achievement against outcomes;
- the learner's strengths;
- the support needed or provided where relevant;
- constructive feedback commenting on the performance in relation to the learner's previous performance and the requirements of the subject; and
- the learner's developmental progress in learning how to learn.

In addition, report cards should include the following:

- name of school;
- name of learner;
- learner's grade;
- year and term;
- space for signature of parent or guardian;
- signature of teacher and of principal;
- date;
- dates of closing and re-opening of school;
- school stamp; and
- school attendance profile of learner.

ASSESSMENT OF LEARNERS WHO EXPERIENCE BARRIERS TO LEARNING

The assessment of learners who experience any barriers to learning will be conducted in accordance with the recommended alternative and/or adaptive methods as stipulated in the Qualifications and Assessment Policy Framework for Grades 10–12 (General) as it relates to learners who experience barriers to learning.

COMPETENCE DESCRIPTIONS FOR ELECTRICAL TECHNOLOGY

The Competence Descriptions are an example of a reporting tool. They report on the learners' level of achievement based on the Learning Outcomes and Assessment Standards that are clustered in a holistic rubric.

Grade 10

Code	Scale	Competence Descriptions
6	**Outstanding 80%–100%**	**At the end of Grade 10 the learner with Outstanding Achievement can:**
		■ Independently analyse and apply the technological process to solve a problem in a real-life situation, taking cognisance of indigenous knowledge systems.
		■ Independently illustrate basic safety methods in the workplace and apply basic first aid with sensitivity to health issues such as HIV/Aids.
		■ Use a critical approach in the application, care and the use of measuring instruments.
		■ Analyse the principle of operation of electrical, electronic and logic systems.
		■ Independently analyse human rights issues and employment opportunities within the South African context.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Outstanding Achievement can:

- Independently analyse and apply the technological process to solve a problem in a real-life situation with recommendations, using relevant terminology and taking cognisance of indigenous knowledge systems.
- Independently apply and demonstrate safety methods in the workplace and apply basic first aid with sensitivity to health issues such as HIV/Aids;
- Use a critical approach in the application, care and use of measuring instruments.
- Analyse the principle of operation of electrical, electronic-and logic systems.
- Independently analyse and interpret human rights issues and employment opportunities within the South African context, taking into account environmental impact.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Outstanding Achievement can:

- Identify, define, analyse and interpret the technological process to solve a problem in a real-life situation with detailed explanations and recommendations, using correct terminology and taking cognisance of indigenous knowledge systems.
- Analyse and evaluate safety methods in the workplace and apply basic first aid with sensitivity to health issues such as HIV/Aids.
- Use a critical approach in the application, care and use of measuring instruments.
- Analyse the principle of operation and application of electrical, electronic and logic systems.
- Analyse and interpret human rights and access to employment issues as well as employment opportunities within the South African context, taking into account environmental impact.

Grade 10

Code	Scale	Competence Descriptions
5	**Meritorious 60%–79%**	**At the end of Grade 10 the learner with Meritorious Achievement can:**
		■ Demonstrate comprehensively the technological process to solve a problem in a real-life context while also taking cognisance of different indigenous knowledge systems.
		■ Demonstrate and comprehensively compare basic safety methods in the workplace and apply basic first aid with sensitivity to health issues such as HIV/Aids.
		■ Demonstrate the ability to select, care for and use tools and measuring instruments.
		■ Demonstrate and compare the operation principle of electrical, electronic and logic systems.
		■ Demonstrate and comprehensively compare human rights issues and entrepreneurship opportunities within the South African context.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Meritorious Achievement can:

- Demonstrate comprehensively the technological process to solve a problem in a real-life context with recommendations, using correct technological terminology and taking cognisance of different indigenous knowledge systems.
- Demonstrate safety methods in the workplace and apply basic first aid with sensitivity to health issues such as HIV/Aids.
- Demonstrate the ability to apply, select and care for measuring instruments.
- Demonstrate the operation and principles of electrical, electronic-and logic systems.
- Demonstrate an awareness of human rights issues and entrepreneurship opportunities within the South African context, taking into account environmental impact.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Meritorious Achievement can:

- Demonstrate comprehensively the technological process to solve a problem in a real-life context with detailed explanations and recommendations, using correct technological terminology and taking cognisance of different indigenous knowledge systems.
- Apply and compare safety methods in the workplace and apply basic first aid with sensitivity to health issues such as HIV/Aids.
- Demonstrate the ability to apply, select and care for measuring instruments.
- Demonstrate the operation and application principles of electrical, electronic and logic systems.
- Categorises human rights issues and employment and entrepreneurship opportunities within the South African context, taking into account environmental impact.

Grade 10

Code	Scale	Competence Descriptions
4	**Satisfactory 50%–59%**	**At the end of Grade 10 the learner with Satisfactory Achievement can:**

- Apply the technological process to solve a problem in a real-life situation, while taking cognisance of indigenous knowledge systems.
- Explain basic safety in the workplace and basic first aid with reference to health issues such as HIV/Aids.
- Explain the selection, care and use of tools and measuring instruments.
- Explain the operation principle of electrical, electronic and logic systems.
- Explain human rights issues and entrepreneurship opportunities within the South African context.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Satisfactory Achievement can:

- Apply the technological process to solve a problem in a real-life situation with recommendations, using correct technological terminology and taking cognisance of indigenous knowledge systems.
- Explain basic safety in the workplace and basic first aid with reference to health issues such as HIV/Aids.
- Explain the application of measuring instruments.
- Explain the operation and principles of electrical, electronic and logic systems.
- Explain of human rights issues and entrepreneurship opportunities within the South African context, taking into account environmental impact.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Satisfactory Achievement can:

- Apply the technological process to solve a problem in a real-life situation with explanations, using technological terminology and taking cognisance of indigenous knowledge systems.
- Explain basic safety in the workplace and first aid with reference to health issues such as HIV/Aids.
- Demonstrate the application of measuring instruments.
- Explain the operation and application principles of electrical, electronic-and logic systems.
- Compare human rights issues and their influence on employment and entrepreneurship opportunities within the South African context, taking into account environmental impact.

Grade 10

Code	Scale	Competence Descriptions
3	**Adequate 40%–49%**	**At the end of Grade 10 the learner with Adequate Achievement can:**

- Apply with minimal guidance the technological process required to solve a problem, taking cognisance of indigenous knowledge systems.
- Describe with minimal guidance basic safety methods in the workplace and first aid with reference to HIV/Aids.
- Describe the selection, care and use of tools and measuring instruments.
- Describe with minimal guidance the operation principle of electrical, electronic-and logic systems.
- Describe human rights issues and entrepreneurship opportunities within the South African context.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Adequate Achievement can:

- Apply with minimal guidance the technological process to solve a problem in a real-life situation, using varied technological terminology and taking cognisance of indigenous knowledge systems.
- Describe with minimal guidance basic safety methods in the workplace and first aid with reference to HIV/Aids.
- Describe the use of measuring instruments.
- Describe the operation and principles of electrical, electronic-and logic systems.
- Describe human rights issues and entrepreneurship opportunities within the South African context, taking into account environmental impact.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Adequate Achievement can:

- Apply with minimal guidance the technological process to solve a problem in a real-life situation with explanations, using technological terminology and taking cognisance of indigenous knowledge systems.
- Describe with minimal guidance basic safety methods in the workplace and first aid with reference to HIV/Aids.
- Describe the operating principle of measuring instruments.
- Describe the operation and application principles of electrical, electronic and logic systems.
- Explain human rights issues and their influence on employment and entrepreneurship opportunities within the South African context, taking into account environmental impact.

Grade 10

Code	Scale	Competence Descriptions
2	**Partial 30%–39%**	**At the end of Grade 10 the learner with Partial Achievement can:**
		■ Apply with assistance the technological process to solve a problem, taking cognisance of indigenous knowledge systems
		■ Describe with assistance safety methods in the workplace and basic first aid with reference to HIV/Aids.
		■ Describe with assistance the selection, care and use of tools and measuring instruments.
		■ Describe with limited knowledge the operation principle of electrical, electronic-and logic systems.
		■ Describe with assistance human rights issues and entrepreneurship opportunities within the South African context.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Partial Achievement can:

- Apply with the assistance the technological process to solve a problem in a real-life situation, using limited technological terminology and taking into cognisance indigenous knowledge systems, with little competence.
- Describe with assistance safety methods in the workplace and basic first aid with reference to HIV/AIDS;
- Describe with assistance the use of measuring instruments;
- Describe with limited knowledge the basic operation and principles of electrical -, electronic-and logic systems; and
- Describe with little understanding human rights issues and entrepreneurship opportunities within the South African context, taking into account environmental impact.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Partial Achievement can:

- Apply with assistance the technological process to solve a problem in a real-life situation with little understanding, using limited technological terminology and taking cognisance of indigenous knowledge systems.
- Describe with assistance safety methods in the workplace and basic first aid with reference to HIV/AIDS;
- Describe with assistance the application of measuring instruments;
- Describe with limited knowledge the operation and application principles of electrical -, electronic-and logic systems; and
- Recognise some human rights issues and their influence on employment and entrepreneurship opportunities within the South African context, taking into account environmental impact.

Grade 10

Code	Scale	Competence Descriptions
1	**Inadequate 0%–29%**	**At the end of Grade 10 the learner with Inadequate Achievement can:**
		■ Apply with limited knowledge the technological process to solve a problem, taking cognisance of indigenous knowledge systems.
		■ Describe limited knowledge safety methods in the workplace and basic first aid with reference to HIV/Aids.
		■ Describe limited knowledge the selection, care and use of tools and measuring instruments.
		■ Describe with limited knowledge the operation principle of electrical and electronic circuits and appliances.
		■ Describe with limited knowledge human rights issues and entrepreneurship opportunities within the South African context.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Inadequate Achievement can:

- Apply with limited knowledge the technological process to solve a problem in a real-life situation, using no or limited technological terminology and taking no or little cognisance of indigenous knowledge systems.
- Describe only a few basic safety methods and basic first aid with little reference to HIV/Aids.
- Describe with limited knowledge the use of measuring instruments.
- Describe with limited knowledge the basic operation principles of electrical, electronic and logic systems.
- Describe limited human rights issues and entrepreneurship opportunities with little understanding.
- Describe with limited understanding how technological change influences the lifestyle of different cultures and the environment.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Inadequate Achievement can:

- Apply with limited knowledge the technological process to solve a problem in a real-life situation with little or no understanding, using a no or little technological terminology but taking cognisance of indigenous knowledge systems.
- Describe few basic safety methods and a few basic first aid methods with no reference to HIV/Aids.
- Describe with limited knowledge the operating principle of measuring instruments;
- Describe with limited knowledge the operation and application principles of electrical, electronic and logic systems.
- Demonstrate with limited knowledge human rights issues and their influence on employment and entrepreneurship opportunities within the South African context, taking into account environmental impact.

GLOSSARY

amplitude modulation (AM) – a system of modulating; a carrier in which the amplitude of the carrier is changed in sympathy with the modulating signal

amplifier – a device designed to provide for a gain in current and/or voltage and may also in some instances also be used to match impedances

AND- gate – is a logic gate that will have a logic 1 output when and only when all the inputs are at logic 1

binary logic – an assembly of digital logic elements which operate with two distinct states

binary number – a number system to the base 2

bipolar-transistor – a transistor in which current is carried through the semiconductor both by holes and electrons

Boolean algebra – a system of formal logic used for minimising complex digital systems

capacitor – a component used in electronic circuits, exhibiting the property of capacitance

conductor – a material through which an electric current can flow relatively easily

conventional current – electric current, regarded as flowing from positive to negative

Delta network – a combination of three components connected in series to form a triangle like the Greek letter delta; also known as a mesh connection

demodulation – the recovery of a modulating signal from a modulated carrier

diac – a bi-directional break over a diode; often used for triggering a triac

digital electronics – the branch of electronics concerned with the processing of digital systems, usually in binary

diode – a component, either semiconductor or thermionic, that permits current to flow through it in one direction only

earth – a term used to indicate an electrical ground

energy – focuses on domestic, industrial, generation and transmission services

entrepreneur (ship) – a person who invents or identifies a useful idea and then sets up a business using that idea

fuse – a protective device that opens a circuit on overcurrent and is used for protection of systems

frequency – generally the range of frequencies that can be processed by an electronic system

integrated circuit – an electronic system, or part of a system, produced on a silicon chip using microelectronic techniques

IEC – International Electrotechnical Commission who is responsible for worldwide standards

impedance – the ratio of the voltage applied to a circuit to the current flowing in the circuit; similar to resistance, but applicable to alternating currents and voltages

Kirchhoff's current law (KCL) – the algebraic sum of the current and/or currents entering a point is equal to the algebraic sum of the current and/or currents leaving that point

Kirchhoff's voltage law (KVL) – the algebraic sum of the voltage drops in a closed network are equal to the algebraic sum of the applied voltage and/or voltages

logic – the basic principles and applications of truth tables, interconnections of on/off circuit elements and other factors involved in mathematical computation in a computer; also used as a general term for various types of gates, flip-flops, and other on/off circuits used to perform problem-solving functions in a digital computer

modulation – variation of the frequency, phase or magnitude of a high frequency waveform in accordance with a waveform of lower frequency

multimeter – a general -purpose measuring instrument, usually able to measure resistance, current and voltage

negative feedback – feedback applied to a system in such a way that it tends to reduce the input signal that results in the feedback

NOT-gate – a logic gate that will have an output of logic 1 when and only when one of the inputs is at logic 0

NPN – one of the two alternative types of bipolar transistors

Ohm's law – the current is directly proportional to the applied voltage and inversely proportional to the resistance of that network, when the temperature is kept constant (only applicable to direct current networks)

operational amplifier – a highly stable, gain, DC amplifier, usually produced as a single integrated circuit

opto-electronics – electronic systems or devices that involve the use of light

oscillator – an electronic system that produces a regular periodic output

oscilloscope – an instrument for displaying electrical waveforms on a cathode ray tube

photo-resistor – also known as an LDR (light-dependent resistor), a resistor whose value depends upon the amount of light falling on it

Programmable Logic Controller (PLC) – a control device, normally used in industrial control applications, that employs the hardware architecture of a computer and a relay ladder diagram language

power supply – source of electrical energy

positive feedback – feedback applied to a system in such a way that the feedback tends to increase the input signal causing the feedback

protective device – a particular type of equipment used in electric power systems to detect abnormal conditions and to initiate appropriate corrective action

rectification – the process of converting an alternating current to a unidirectional current

relay – an electromechanical device in which an electric current closes a switch

resistance – the property of a material that resists the flow of electrical current

resonance – a condition which will exist in a network containing an inductor and a capacitor when the two reactance equal one another

Star network – a set of three or more branches with one terminal of each connected at a common node to give the form of a star; also known as a U connection

thyristor – a component similar to a semiconductor diode but having in addition a gate connection by which the component, normally non- conducting, can be triggered into conduction

triac – a semiconductor component similar to the thyristor but which will conduct in either direction

uni-junction transistor – a semiconductor device used in some oscillators

voltage regulation – a process to maintain the terminal voltage within required limits despite variations in input voltage or load