education

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REPUBLIC OF SOUTH AFRICA

NATIONAL CURRICULUM STATEMENT GRADES 10-12 (GENERAL)

LEARNING PROGRAMME GUIDELINES

ENGINEERING GRAPHICS AND DESIGN

JANUARY 2008

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SECTION 1

INTRODUCTION

1.1 INTRODUCING THE NATIONAL CURRICULUM STATEMENT

1.1.1 BACKGROUND

In 1995 the South African government began the process of developing a new curriculum for the school system. There were two imperatives for this. First, the scale of change in the world, the growth and development of knowledge and technology and the demands of the 21st Century required learners to be exposed to different and higher level skills and knowledge than those required by the existing South African curricula. Second, South Africa had changed. The curricula for schools therefore required revision to reflect new values and principles, especially those of the Constitution of South Africa.

The first version of the new curriculum for the General Education Band, known as Curriculum 2005, was introduced into the Foundation Phase in 1997. While there was much to commend the curriculum, the concerns of teachers led to a review of the Curriculum in 1999. The review of Curriculum 2005 provides the basis for the development of the National Curriculum Statement for General Education and Training (Grades R–9) and the National Curriculum Statement for Grades 10–12.

1.1.2 THE NATIONAL CURRICULUM STATEMENT

The National Curriculum Statement consists of 29 subjects. Subject specialists developed the Subject Statements which make up the National Curriculum Statement. The draft versions of the Subject Statements were published for comment in 2001 and then re-worked to take account of the comments received. In 2002 24 subject statements and an overview document were declared policy through Government Gazette. In 2004 five subjects were added to the National Curriculum Statement. The National Curriculum Statement now consists of the Subject Statements for the following subjects:

- Languages – 11 official languages (each counted as three subjects to cater for the three levels Home Language, First Additional Language and Second Additional Language); 13 non-official languages
- Mathematics; Mathematical Literacy; Physical Sciences; Life Sciences; Computer Applications Technology; Information Technology
- Accounting; Business Studies; Economics
- Geography; History; Life Orientation; Religion Studies
- Consumer Studies; Hospitality Studies; Tourism
- Dramatic Arts; Dance Studies; Design; Music; Visual Arts
- Agricultural Sciences, Agricultural Management Practices, Agricultural Technology

- Civil Technology; Mechanical Technology; Electrical Technology; Engineering Graphics and Design

1.1.3 NATIONAL SENIOR CERTIFICATE

The *National Senior Certificate: A Qualification on Level 4 of the National Qualifications Framework (NQF)* provides the requirements for promotion at the end of Grades 10 and 11 and the awarding of the National Senior Certificate at the end of Grade 12. This document replaces two of the original National Curriculum Statement documents: the *Overview* and the *Qualifications and Assessment Policy Framework.*

1.1.4 SUBJECT ASSESSMENT GUIDELINES

The Subject Assessment Guidelines set out the internal or school-based assessment requirements for each subject and the external assessment requirements. In addition, the *National Protocol for Recording and Reporting (Grades R-12)* (an addendum to the policy, *The National Senior Certificate*) has been developed to standardise the recording and reporting procedures for Grades R to 12. This protocol came into effect on 1 January 2007.

1.2 INTRODUCING THE LEARNING PROGRAMME GUIDELINES

1.2.1 PURPOSE AND CONTENT OF THE LEARNING PROGRAMME GUIDELINES

The Learning Programme Guidelines aim to assist teachers and schools in their planning for the introduction of the National Curriculum Statement. The Learning Programme Guidelines should be read in conjunction with the National Senior Certificate policy and the National Curriculum Statement Subject Statements.

Section 2 of the Learning Programme Guidelines suggests how teaching the particular subject may be informed by the principles which underpin the National Curriculum Statement.

Section 3 suggests how schools and teachers might plan for the introduction of the National Curriculum Statement. The Department of Education encourages careful planning to ensure that the high skills, high knowledge goals of the National Curriculum Statement are attained.

The Learning Programme Guidelines do not include sections on assessment. The assessment requirements for each subject are provided in the Subject Assessment Guidelines which come into effect on 1 January 2008.

1.2.2 WHAT IS A LEARNING PROGRAMME

INTRODUCTION

A Learning Programme assists teachers to plan for sequenced learning, teaching and assessment in Grades 10 to 12 so that all Learning Outcomes in a subject are achieved in a progressive manner. The following three phases of planning are recommended:

Phase 1 – develop a *Subject Framework* for grades 10 to 12

Phase 2 – develop a *Work Schedule* for each grade

Phase 3 – develop *Lesson Plans* to cover each classroom contact session

It is recommended that the teachers of a subject at a school or cluster of schools first put together a broad subject outline (Subject Framework) for the three grades to arrive at an understanding of the content of the subject and the progression which needs to take place across the grades (see Section 3.3.1). This will assist with the demarcation of content for each grade. Thereafter, teachers of the subject teaching the same grade need to work together to develop a year long Work Schedule. The Work Schedule should indicate the sequence in which the content and context will be presented for the subject in that particular grade (see Section 3.3.2). Finally, individual teachers should design Lesson Plans using the grade-specific Work Schedule as the starting point. The Lesson Plans should include learning, teaching and assessment activities that reflect the Learning Outcomes and Assessment Standards set out in the Subject Statements (see Section 3.3.3). Learning Programmes should accommodate diversity in schools and classrooms but reflect the core content of a national curriculum.

An outline of the process involved in the design of a Learning Programme is provided on page 6.

DESIGNING A LEARNING PROGRAMME

A detailed description of the process involved in the design of a Learning Programme is provided in Sections 3.3.1 – 3.3.3 of the Learning Programme Guidelines. The first stage, the development of a Subject Framework does not require a written document but teachers are strongly advised to spend time with subject experts in developing a deep understanding of the skills, knowledge and values set out in the subject statements. The quality and rigour of this engagement will determine the quality of teaching and learning in the classroom.

Once the Subject Framework has been completed, teachers should develop Work Schedules and Lesson Plans. Examples of Work Schedules and Lesson Plans are provided in the Learning Programme Guidelines. Teachers are encouraged to critically engage with these formats and develop their own.

- ***Developing a Subject Framework (Grades 10-12)***

Planning for the teaching of subjects in Grades 10 to 12 should begin with a detailed examination of the scope of the subject as set out in the Subject Statement. No particular format or template is recommended for this first phase of planning but the steps recommended should be used as a checklist.

Although no prescribed document is required for this stage of planning, school-wide planning (timetables, requisitioning, teacher development, classroom allocation) as well as the development of grade-specific work schedules would benefit from short documents which spell out:

- The scope of the subject – the knowledge, skills and values; the content; the contexts or themes; electives etc. to be covered in the three grades for each subject
- A three-year assessment plan for the subject
- The list of LTSM required for the subject

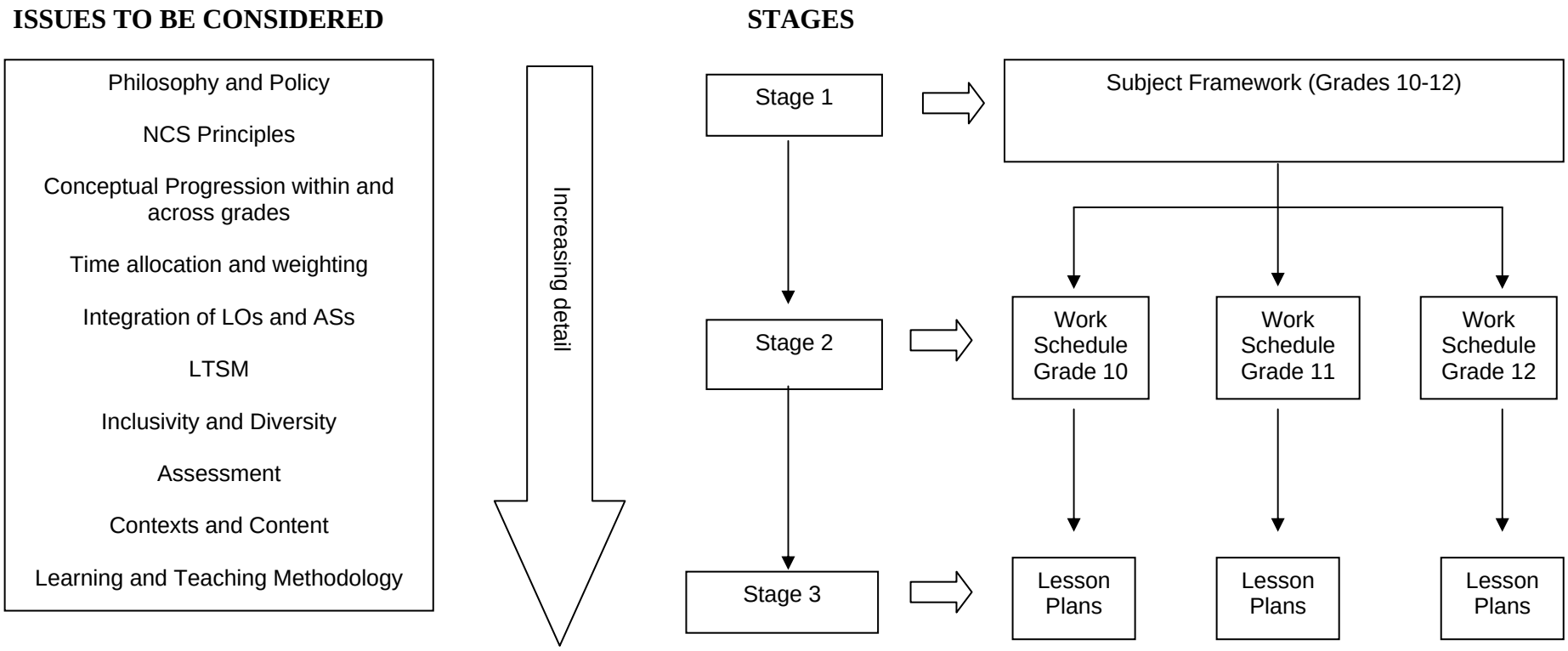
- ***Designing Work Schedules***

This is the second phase in the design of a Learning Programme. In this phase teachers develop Work Schedules for each grade. The Work Schedules are informed by the planning undertaken for the Subject Framework. The Work Schedules should be carefully prepared documents that reflect what teaching and assessment will take place in the 36-40 weeks of the school year.

- ***Designing Lesson Plans***

Each grade-specific Work Schedule must be divided into units of deliverable learning experiences, that is, Lesson Plans. Lesson Plans are not equivalent to periods in the school timetable and each contains a coherent series of teaching, learning and assessment activities. A Lesson Plan adds to the level of detail for each issue addressed in the Work Schedule. It also indicates other relevant issues to be considered when teaching and assessing a subject.

FIGURE 1: RELATIONSHIP BETWEEN THE 3 STAGES OF PLANNING WHEN DEVELOPING A LEARNING PROGRAMME



SECTION 2

INTRODUCING ENGINEERING GRAPHICS AND DESIGN

2.1 WHAT IS ENGINEERING GRAPHICS AND DESIGN?

The essence of Engineering Graphics and Design is to communicate technological ideas, concepts and designs using a universally accepted combination of lines and symbols. Engineering Graphics and Design therefore serves as a means of communication between those involved in the design, production and engineering disciplines.

This subject also incorporates indigenous and global knowledge systems and draws on concepts found in Civil, Electrical and Mechanical Technologies.

In Engineering Graphics and Design cognitive skills refer to critical, logical and creative thinking involving analysis and synthesis applied to practical and real life problems. Manipulative skills refer to those skills needed when drawing freehand and using instruments and computer systems for design.

2.1.1 Learning outcomes

The four Learning Outcomes in Engineering Graphics and Design are interrelated, and should be taught in an integrated way so that they are not dealt with in isolation.

All Learning Outcomes are equally important, but do not have the same weighting in the allocation of time and resources. Learning Outcome 1 reflects the interrelationship of technology, society and the environment and should be integrated into all the other LOs. Learning Outcome 2 outlines the design process and is used as the organising tool that forms the framework into which the other LOs should be incorporated. Learning Outcome 3 reflects knowledge and understanding, whilst Learning Outcome 4 deals with the application of this knowledge.

Learning Outcome 1: Technology, Society and the Environment

The learner is able to demonstrate an awareness and understanding of the inter-relationship between Engineering Graphics and Design, Society and the Environment.

Learning Outcome 2: Design Process

The learner is able to know, understand and apply the design.

Learning Outcome 3: Knowledge and Understanding

The learner is able to demonstrate knowledge and understanding of the principles and concepts of graphic communications within the contexts of Civil, Electrical and Mechanical Technologies.

Learning Outcome 4: Application of Knowledge

The learner is able to demonstrate the application of engineering graphic skills and techniques across a range of disciplines effectively and responsibly.

2.1.2 The Shift from NATED 550 (Technical Drawing) to Engineering Graphics and Design

Technical Drawing uses mechanical engineering and geometrical drawing to develop three-dimensional perception and to teach projection methods. In Engineering Graphics and Design knowledge, skills and values are contextualised in Civil, Electrical & Mechanical Technology, and the Design Process is used as an organizing tool. The teacher should ensure the relevance of the subject, and encourage research into real life situations. All four Leaning Outcomes should be taught in an integrated way and not taught in isolation.

	NATED Report 550	**National Curriculum Statement**
	Technical Drawing	**Engineering Graphics and Design**
Context	Geometrical and Mechanical	Civil, Electrical and Mechanical
	Instrument Drawing with some Freehand Drawing	Freehand Drawing, Instrument Drawing and Computer Aided Draughting
Assessment	Examination orientated	School based and examinations
	First Angle Projection	First and Third Angle Projection
Methodology	Unrelated to Industry and needs of country	Relates to Industry and the needs of the country
	Limited links to other subjects	Encourages links with other subjects
	Environmental Issues and Human Rights not addressed	Strong Emphasis on Environmental Issues, HIV/Aids and Human Rights
	Little or no Creative thinking	Emphasizes Critical and Creative thinking Skills

2.2 WHAT IS THE PURPOSE OF ENGINEERING GRAPHICS AND DESIGN?

Engineering Graphics and Design aims to develop the learner's ability to address problems and exploit opportunities in a creative and innovative way. Learners are equipped to apply cognitive skills, such as critical and creative thinking, analysis, synthesis and logic to practical, real life design and engineering problems.

This subject equips learners with the skills, knowledge and values to function in an engineering and design environment. It also stimulates an innovative and entrepreneurial spirit and enhances learners' technological literacy. The learner will thus be equipped to appreciate the interaction between people's values, society, environment, human rights and technology.

Application of the Design Process helps to solve Civil, Electrical and Mechanical problems analytically and graphically and to understand the concepts and knowledge used in Engineering Graphics and Design. These concepts and knowledge are to be used responsibly and purposefully, taking into account Indigenous Knowledge Systems (IKS), and the challenges facing society.

Learning in this subject will enable learners to continue with their studies in further and/or higher education institutions and professional bodies, and to pursue different career paths.

2.3 WHAT IS THE RELATIONSHIP BETWEEN ENGINEERING GRAPHICS AND DESIGN AND THE NATIONAL CURRICULUM STATEMENT PRINCIPLES?

The Constitution of the Republic of South Africa (Act 108 of 1996) provides a basis for curriculum transformation and development in South Africa. The National Curriculum Statement Grades 10-12 (General) for Engineering Graphics and Design stipulates Learning Outcomes, Assessment Standards and Competency Levels for Engineering Graphics and Design learners.

This Curriculum is based on the following principles:

- Social transformation
- Outcomes Based Education (OBE)
- High knowledge and high skills
- Integration and applied competence
- Progression
- Articulation and portability
- Human rights, exclusivity, environmental and social justice
- Valuing Indigenous Knowledge Systems
- Credibility, quality and efficiency

These principles are discussed below.

2.3.1 Social transformation

Engineering Graphics and Design will equip learners with knowledge, skills and values that are relevant for the world of work. Insight into the application of technology will help learners contribute to raising the standards of services in communities such as the provisioning of housing, sanitation, water and electrification. For example, the teacher will teach learners to design a simple dwelling using sound technological principles and practices. The teacher must use available resources to benefit all learners so that access to employment and further studies is promoted.

2.3.2 Outcomes-Based Education

Engineering Graphics and Design makes use of learning outcomes and assessment standards to describe what a learner should know and be able to demonstrate i.e. the skills, knowledge, and values that are the results of learning. Engineering Graphics and Design encourages learners to develop inquiring and problem solving skills which support the practical application of knowledge in technology and involves active and high level teaching, learning and assessment.

2.3.3 High knowledge and high skills

Engineering Graphics and Design aims to develop a high level of knowledge and skills for all learners, including those learners with special educational needs. Therefore the teacher must set high standards through planning, managing and assessing learning activities. For example, the symbols and conventions used in learners' drawings must accord with the SANS (South African National Standards) and by implication, global standards.

2.3.4 Integration and applied competence

Engineering Graphics and Design must link directly with the Technology Subjects, and may link indirectly with other subjects. In planning activities, the learning outcomes, assessment standards and the content must be integrated in the context of Civil, Electrical and Mechanical Technologies.

For example, Learning Outcome 2, namely the Design Process, should not be taught in isolation, but should be the organising concept for the integration of the other Learning Outcomes. The teacher must ensure that competence is not merely a matter of theory but application of knowledge in real life.

Integration is achieved within and across subjects and fields of learning. The integration of knowledge and skills across areas of learning and application is crucial for achieving applied competence as defined in the National Qualifications Framework (NQF). There are also many links between Engineering Graphics and Design and other subjects.

2.3.5 Progression

The teacher must ensure that there is a definite progression from simple to complex knowledge and skills within each grade and from one grade to another.

2.3.6 Articulation and Portability

In Engineering Graphics and Design the learning outcomes, assessment standards and content framework allow portability across and within Grades 10-12. Articulation refers to the relationship between qualifications in different NQF levels or bands in ways that promote access from one qualification to another. This is especially important for qualifications falling within the same learning field.

2.3.7 Human Rights, Inclusivity, Environmental and Social Justice

Engineering Graphics and Design addresses issues of diversity such as poverty, inequality, race, gender, language, age, disability, environmental issues and other factors. The teacher must ensure that all learners develop their full intellectual, social, emotional, spiritual and physical potential through the development of appropriate learning programmes and choice of appropriate assessment instruments.

2.3.8 Valuing Indigenous Knowledge Systems (IKS)

Engineering Graphics and Design acknowledges the richness of the history and heritage of South Africa and its constitution. Indigenous Knowledge Systems, from whatever context, should not be seen as static but dynamic and responsive to change from influences that may be local, national, continental or global. The teacher can plan activities where the assessment criteria present opportunities for individual learners, taking into account cultural diversity in our society. For example, the indigenous knowledge of thatch roofing in Zulu nation might differ from that of the Sotho nation as well as modern thatch roofing. Indigenous people have developed the use of thatch roofing with its unique truss system for South African conditions.

2.3.9 Credibility, quality and efficiency

Engineering Graphics and Design aims to achieve **credibility, quality and efficiency** through pursuing a transformational agenda and through providing an education that is comparable in quality, breadth and depth to those of other countries.

In planning, the teacher must ensure that Engineering Graphics and Design is in line with national and international standards, developments and relevance.

2.4 PROFILE OF AN ENGINEERING GRAPHICS AND DESIGN LEARNER

The teacher should establish the level of knowledge, skills and competence of the learners in Grade 10. This will help the teacher to plan appropriate activities for further development of learners. The learner who takes Engineering Graphics and Design would have been exposed to the Technology Learning Area in the NCS Grades R-9.

Links between the NCS (Grades R-9) and the NCS (Grades 10-12) include the learner's ability to:

- apply the Design Process using critical and creative problem solving skills;
- communicate using graphics and other means;
- apply skills in listening, speaking, reading, thinking and writing;
- reason independently and critically;
- work as individuals and also in a group situation;
- think logically, analytically, holistically and laterally;
- transfer skills from familiar to unfamiliar situations;
- consider and debate important issues such as those concerning human rights and the environment;
- realise that problems can have multiple solutions; and
- demonstrate achievement of the Critical and Developmental Outcomes.

Learners should be keen, flexible and inquisitive to obtain and evaluate information for themselves. In addition, they should have a positive attitude toward society based on respect for democracy, equality, human dignity and social justice.

2.5 RELATIONSHIP BETWEEN ENGINEERING GRAPHICS AND DESIGN LEARNING OUTCOMES AND CRITICAL AND DEVELOPMENTAL OUTCOMES

In order to contribute to the full personal development of each learner and to the social and economic development of society at large, the teacher should in planning ensure that the Critical and Developmental Outcomes are integrated in a meaningful way. The following are examples of how this could be done:

- reflecting on and exploring a variety of strategies to learn more effectively;
- participating as responsible citizens in the life of local, national and global communities;
- being culturally and aesthetically sensitive across a range of social contexts;
- exploring education and career opportunities; and
- developing entrepreneurial opportunities.

CRITICAL OUTCOMES require Learners to be able to:	APPLICATION IN ENGINEERING GRAPHICS AND DESIGN (Grades 10-12)	Engineering Graphics and Design LOs
Identify and **solve problems** and make decisions using critical and creative thinking.	Engage in creative, innovative thinking in solving problems, needs and wants when conceptualising and realizing possible solutions.	**2, 3, 4**
Work effectively with others as members of a team, group or organisation and community	The Design process often requires participants to work together which involves sharing of ideas, developing interviewing skills, democratic practices and ethical responsibility	**1, 2, 4**
Organise and manage themselves and their activities responsibly and effectively	Engineering Graphics and Design learners must learn to be self disciplined, be able to plan, organise and manage their work, keep to time schedules, be committed to the task and take responsibility for their actions	**1, 4**
Collect, analyse, organise and **critically evaluate** information	Learners must be able to observe and record data in a variety of ways so that they are able to analyse, interpret and critically evaluate information and apply it in theory and practice.	**2, 3, 4**
Communicate effectively using visual, symbolic and/or language skills in various modes.	Learners need to be able to communicate through verbal, non-verbal and symbolic language forms that characterize Engineering Graphics and Design. For example projecting views, drawing electronic circuits, castings, floor plans and sections, etc.	**1, 2, 3, 4**
Use science and technology effectively and critically, **showing responsibility** towards the environment and the health of others	Engineering Graphics and Design concepts and end products must show effective social, ethical and environmental responsibility.	**1, 2, 4**
Demonstrate an understanding of the world as a set of related systems by recognizing that **problem solving** contexts do not exist in isolation	The Design Process involves learners in understanding how their own problem solving activities are influenced by, or may impact on, local, national and global contexts	**1, 2, 3, 4**

DEVELOPMENTAL OUTCOMES require Learners to be able to:	APPLICATION IN ENGINEERING GRAPHICS AND DESIGN (Grades 10-12)	Engineering Graphics and Design LOs
Reflect and explore a variety of strategies to learn more effectively.	Engineering Graphics and Design combines theory with practice which enables learners to continually evaluate their knowledge and skills while at the same time supporting and enhancing teaching and learning.	**1, 2, 3 and 4**
Participate as **responsible citizens** in the life of local, national and global communities.	Learners develop responsibility towards their communities, locally, nationally and globally to understand the contribution of Engineering Graphics and Design towards the development of a vibrant industry.	**1, 2, 3 and 4**
Be **culturally and aesthetically sensitive** across a range of social contexts.	Engineering Graphics and Design can influence or be influenced by other cultures and has the potential to be a powerful agent for change, transformation and affirmation.	**1, 3 and 4**
Explore education and career opportunities.	The Engineering Graphics and Design field offers a varied range of professional and vocational opportunities, which can enable learners to make a significant economic contribution to self and society through specific training.	**1, 3 and 4**
Develop **entrepreneurial** opportunities.	The Engineering Graphics and Design field offers a varied range of professional and vocational opportunities through commitment to best practice, the ability to initiate, market and manage skills, processes and products.	**1, 2, 3 and 4**

2.6 WAYS TO ACHIEVE ENGINEERING GRAPHICS AND DESIGN LEARNING OUTCOMES

2.6.1 Integration of Learning Outcomes

The four Learning Outcomes are not presented in any specific order. The teacher must ensure that each supports and underpins the other. This approach supports and expands learners' opportunities to attain skills, acquire knowledge and develop values across the curriculum.

For example, LO2 involves the Design Process, and LO 1 has to do with social and environmental issues. These can be integrated with LO3 (knowledge and understanding) and LO4 (application of knowledge and understanding).

2.6.2 Supporting the Learning Outcomes by means of Assessment Standard

Learning Outcomes are supported by Assessment Standards, which are the stepping-stones required to demonstrate the outcomes. The Engineering Graphics and Design Assessment Standards are minimum requirements for achieving the Learning Outcomes. The teacher should ensure that learners are given various opportunities to meet these minimum requirements, taking into account the learning styles of different learners. There is no single way of clustering assessment standards – they can be clustered in many ways, depending on the needs of the learners and the demands of a particular Learning Programme.

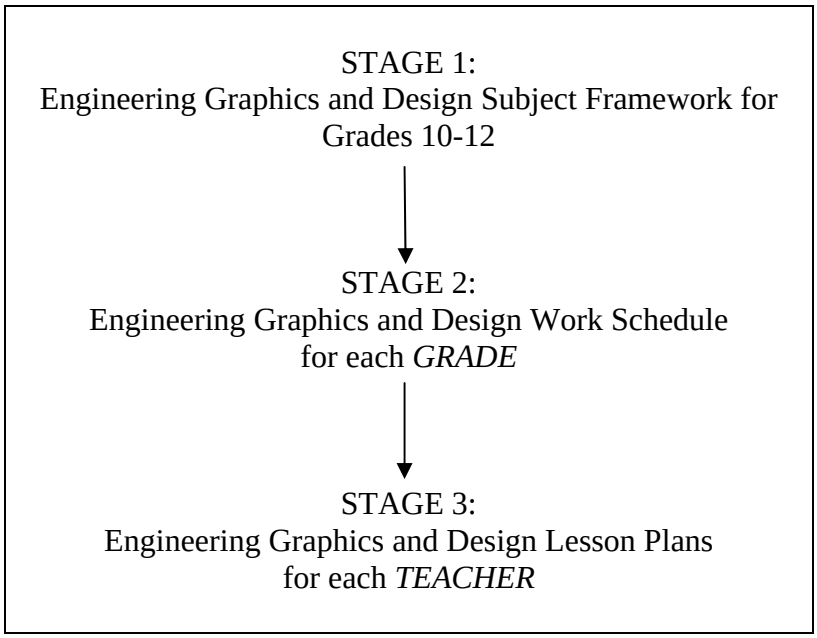
SECTION 3

DESIGNING A LEARNING PROGRAMME FOR ENGINEERING GRAPHICS AND DESIGN

3.1 INTRODUCTION

A Learning Programme is a tool to plan for sequenced learning, teaching and assessment across Grades 10-12 so that all four Learning Outcomes in Engineering Graphics and Design are achieved in a progressive manner. It is recommended that the Engineering Graphics and Design teachers at a school first put together a broad subject outline (i.e. Subject Framework) for Grades 10-12 to arrive at an understanding of the progression which needs to take place across the grades (see Section 3.3.1). This will assist with the demarcation of content for each grade. Thereafter, Engineering Graphics and Design teachers teaching the same grade need to work together and draw from the content and context identified for their grade in the Subject Framework, to develop a Work Schedule in which they indicate the sequence in which the content and context will be presented for Engineering Graphics and Design in that particular grade (see Section 3.3.2). Finally, the individual Engineering Graphics and Design teacher should design Lesson Plans using the grade-specific Work Schedule as the starting point. The Lesson Plans should include learning, teaching and assessment activities (see Section 3.3.3).

An outline of the process involved in the design of a Learning Programme for Engineering Graphics and Design is provided in the diagram below:



The process to be followed in the development of a Learning Programme is not a neatly packaged sequence of numbered steps that follow one another in a particular order. Teachers may find themselves moving back and forth in the process as they plan and critically reflect on decisions taken before moving on to the next decision in the process. The process is therefore not strictly linear and is reflective in nature. For this reason the steps provided in this Section are a guide and should be used as a checklist in the planning process.

3.2 ISSUES TO ADDRESS WHEN DESIGNING A LEARNING PROGRAMME

The issues to be addressed in the development of a Engineering Graphics and Design Learning Programme are presented in a tabular format to indicate the implications of each issue at each of the three stages of the development of a Learning Programme:

- Stage 1 – Subject Framework
- Stage 2 – Work Schedule
- Stage 3 – Lesson Plan

3.2.1 Policies and Principles

STAGE 1 **Subject Framework** **STAGE 2** **Work Schedule** **STAGE 3** **Lesson Plan**	The various Policies that impact on curriculum implementation should be considered throughout the planning process. *NCS*: • Principles: Refer to Section 2.3 to see how Engineering Graphics and Design supports the application of the nine principles of the NCS • Critical and Developmental Outcomes: Refer to Section 2.5 to see how Engineering Graphics and Design supports the application of the Critical and Developmental Outcomes *Other Policies and Legislation*: • White Paper 6, Language in Education Policy, Religion and Education Policy, HIV/AIDS Policy– all have implications for LTSM and teaching methods in Engineering Graphics and Design • White Paper 7 – gives an indication on the use of computers in the classroom and therefore has implications for LTSM and teaching methods in Engineering Graphics and Design

3.2.2 Content

In the NCS Grades 10-12 content means the combination of knowledge, skills and values.

STAGE 1 **Subject Framework**	The content is provided by the ASs. These give an indication of the knowledge, skills and values (KSVs) to be covered in each of the three grades. The Subject Framework sets out the content for the three years (i.e. Grades 10, 11 and 12).
STAGE 2 **Work Schedule**	The Work Schedule sets out the content for one year. Here the focus falls on the grade-specific KSVs required by the NCS.
STAGE 3 **Lesson Plan**	The Lesson Plans set out the content to be covered in each coherent series of learning, teaching and assessment activities. Each Lesson Plan can be one or more weeks in duration.

3.2.3 Integration

Integration involves the grouping of Assessment Standards according to natural and authentic links.

STAGE 1 **Subject Framework**	Integration within the subject should be considered in broad terms during discussions at this stage. All Grade 10-12 teachers should consider integration of ASs within and across the grades.
STAGE 2 **Work Schedule**	The integration and sequencing of the ASs is undertaken in the Work Schedule to ensure that all ASs for a particular grade are covered in the 40-week contact period.

STAGE 3 Lesson Plan	The same groupings of LOs and ASs as arrived at in the Work Schedule should be used to develop a coherent series of learning, teaching and assessment activities for each Lesson Plan.

3.2.4 Conceptual Progression

STAGE 1 Subject Framework	The Subject Framework should indicate the increasing depth of difficulty across Grades 10-12. Progression across the three grades is shown in the ASs per Learning Outcome.
STAGE 2 Work Schedule	Progression in a grade is evident in the increasing depth of difficulty in that particular grade. Grade-specific progression is achieved by appropriately sequencing the groupings of integrated LOs and AS in the Work Schedule.
STAGE 3 Lesson Plan	In the individual Engineering Graphics and Design classroom increasing depth of difficulty is shown in the activities and Lesson Plans. Progression is achieved by appropriately sequencing the activities contained within each Lesson Plan and in the series of Lesson Plans.

3.2.5 Time Allocation and Weighting

STAGE 1 Subject Framework	4 hours per week is allocated to Engineering Graphics and Design in the NCS. This is approximately 160 hours per year. The teachers of the subject should plan how this time will be used for the teaching of Engineering Graphics and Design in the three grades.
STAGE 2 Work Schedule	The groupings of ASs as arrived at in the integration process should be paced across the 40 weeks of the school year to ensure coverage of the curriculum.
STAGE 3 Lesson Plan	The amount of time to be spent on activities should be indicated in the Lesson Plans.

3.2.6 LTSM

LTSM refers to any materials that facilitate learning and teaching. LTSM need to be chosen judiciously because they have cost implications for the school and the learner. The NCS provides scope for the use of a variety of resources. All teachers and learners must have a textbook. However, teachers are required to go beyond the textbook. They do not necessarily need exotic, specialised materials. Rather common and readily available items can be used.

STAGE 1 Subject Framework	Compile a list of general LTSM (text books and other resources) that will be necessary and useful in the teaching, learning and assessment of the content. This assists with the requisition and availability of LTSM at a school.
STAGE 2 Work Schedule	List grade-specific LTSM (resources) required in the learning, teaching and assessment process for the grade.
STAGE 3 Lesson Plan	Identify specific resources related to the individual activities contained within a Lesson Plan.

3.2.7 Assessment

All Grade 10, 11 and 12 learners are expected to complete seven internal tasks for Engineering Graphics and Design. Of the seven tasks, two must be tests, two must be examinations, one must be a Performance Assessment Task and the remaining two tasks can take any form suitable to the teaching and assessment of Engineering Graphics and Design. In addition, Grade 12 learners are required to complete an external examination. See Section 3 of the Subject Assessment Guidelines for Engineering Graphics and Design for further details.

In order to administer effective assessment one must have a clearly defined purpose. It is important that all the tasks are well covered as spelt out in the Subject Assessment Guideline document. By answering the following questions the teacher can decide what assessment activity is most appropriate:

- What concept, skill or knowledge needs to be assessed?
- What should the learners know?
- At what level should the learners be performing?
- What type of knowledge is being assessed: reasoning, memory or process?

Observation-based assessment requires that learner performance be assessed while the learner is actually performing a skill because the teacher should assess the process and not merely the final product. Not all observation-based assessment needs to be recorded. This process can be used to help the learner improve the skills required in Engineering Graphics and Design.

Test-based assessment focuses on assessing the application of knowledge and the presentation of drawings.

The Performance Assessment Task (PAT) for Engineering Graphics and Design focuses mainly on LO2 but integrates the other learning outcomes to differing extents.

Performance-based assessment in Engineering Graphics and Design relies on the availability of a design as evidence of learner performance. This design is accompanied by a portfolio outlining the process from conception to completion. The decisions taken and the rationale behind such decisions are outlined in this portfolio thereby giving insight into the learners' higher order thinking skills, problem solving abilities, ingenuity and innovativeness as well as and understanding of concepts, values and attainment of skills in this subject.

STAGE 1 **Subject Framework**	Develop a three-year assessment plan using the Subject Assessment Guidelines for Engineering Graphics and Design. This should ensure the use of a variety of assessment forms relevant to the subject and progression across the three grades.
STAGE 2 **Work Schedule**	Use the Subject Assessment Guidelines for Engineering Graphics and Design to develop a grade-specific assessment plan. The forms of assessment listed must facilitate the achievement of the particular LOs and ASs in each grouping.
STAGE 3 **Lesson Plan**	Indicate more classroom-specific assessment strategies, by mentioning the methods, forms and tools that will be used to assess learner performance in each activity. HINT: Not all activities need to be assessed – some may just be introductory in nature or for enrichment. The choice of an assessment strategy is determined by the LOs and ASs that have been grouped together for a particular Lesson Plan. The assessment strategy chosen must facilitate the achievement of these particular LOs and ASs in the classroom.

3.2.8 Inclusivity and Diversity

The following steps can be taken to effectively address diversity in the classroom when planning Engineering Graphics and Design teaching activities:

- consider individual past experiences, learning styles and preferences;
- develop questions and activities that are aimed at different levels of ability;
- provide opportunity for a variety of participation levels such as individual, pairs and small group activities;
- consider the value of individual methods ; and
- assess learners based on individual progress.

STAGE 1 **Subject Framework**	Teachers should be sensitive to inclusivity and diversity when identifying content, teaching styles and methods, forms of assessment and LTSM (Resources). Diversity should be accommodated in the following areas: • Learning styles: provide optional activities / different ways of doing same activity • Pace of learning: provide for both slower and faster learners by providing optional extra activities, reading or research, as well as multiple assessment opportunities • Differences in levels of achievement: provide optional extra activities, challenges and materials that cater for these differences between learners. • Gender diversity: ensure that teachers do not inadvertently allow or contribute towards discrimination against boys or girls in the classroom on the basis of gender. • Cultural diversity: recognise, celebrate and be sensitive when choosing content, assessment tasks and LTSM.
STAGE 2 **Work Schedule**	
STAGE 3 **Lesson Plan**	This is catered for as EXPANDED OPPORTUNITIES in the Lesson Plan. Enrichment is provided for high achievers and remediation or other relevant opportunities for learners requiring additional support. It is not necessary to develop an activity to cater for each type of diversity which arises in the classroom. Teachers may find it possible to cater for different diversities within one activity with effective planning.

Teachers should not limit learners from achieving their full potential in Engineering Graphics and Design by imposing assumptions about the learner's capabilities. The subject Engineering Graphics and Design has an inclusive approach, ensuring that all learners, including those with special educational needs, will be actively and creatively engaged in the learning process. Engineering Graphics and Design allows for flexibility in accommodating learner diversity.

3.2.9 Learning and Teaching Methodology

STAGE 1 **Subject Framework**	It is not necessary to record Teaching Methods for either of these stages.
STAGE 2 **Work Schedule**	
STAGE 3 **Lesson Plan**	This is catered for as TEACHING METHOD in the Lesson Plan. It provides an indication of how teaching and learning will take place, that is, how each activity will be presented in the classroom.

3.3 DESIGNING A LEARNING PROGRAMME

A detailed description of the process involved in the design of a Learning Programme for Engineering Graphics and Design is provided in this section (see Sections 3.3.1 – 3.3.3). The process presented here is a suggestion of how to go about designing a Learning Programme.

3.3.1 Subject Framework (Grades 10-12) for Engineering Graphics and Design

Planning for the teaching of Engineering Graphics and Design in Grades 10 to 12 should begin with a detailed examination of the scope of the subject as set out in the Subject Statement. No particular format or template is recommended for this first phase of planning but the five steps below should be used as a checklist.

Although no prescribed document is required for this stage of planning, school-wide planning (timetables, ordering, teacher development, classroom allocation) as well as the development of grade-specific work schedules would benefit from short documents which spell out:

- The scope of the subject – the knowledge, skills and values; the content; the contexts or themes; electives etc. to be covered in the three grades
- A three-year assessment plan
- The list of LTSM required

❶ Clarify the Learning Outcomes and Assessment Standards.

The essential question for Engineering Graphics and Design is: What Learning Outcomes do learners have to master by the end of Grade 12 and what Assessment Standards should they achieve to show that they are on their way to mastering these outcomes?

All learning, teaching and assessment opportunities must be designed down from what learners should know, do and produce by the end of Grade 12. The Learning Outcomes and Assessment Standards that learners should master by the end of Grade 12 are specified in the Engineering Graphics and Design Subject Statement.

❷ Study the conceptual progression across the three grades.

Study the Assessment Standards for Engineering Graphics and Design across the three grades. Progression should be clearly evident across the grades.

❸ Identify the content to be taught.

Analyse the Assessment Standards to identify the skills, knowledge and values to be addressed in each grade. Also consider the content and context in which they will be taught. See Appendix A for suggested content.

❹ Identify three-year plan of assessment.

Use the Subject Assessment Guidelines to guide the three-year assessment plan. Consider what forms of assessment will be best suited to each of the Learning Outcomes and Assessment Standards. This ensures that assessment remains an integral part of the learning and teaching process in Engineering Graphics and Design and that learners participate in a range of assessment activities.

❺ Identify possible LTSM (resources).

Consider which LTSM will be best suited to the learning, teaching and assessment of each Learning Outcome in the three grades using the Assessment Standards as guidance.

3.3.2 Designing Work Schedules for Engineering Graphics and Design

This is the second phase in the design of a Learning Programme. In this phase teachers develop Work Schedules for each grade. The Work Schedules are informed by the planning undertaken for the Subject Framework. The Work Schedules should be carefully prepared documents that reflect what teaching and assessment will take place in the 40 weeks of the school year. See Appendix B for examples of Work Schedules for Grades 10, 11 and 12.

The following steps provide guidelines on how to approach the design of a Work Schedule per grade for Engineering Graphics and Design:

❶ Package the content.

Study the Learning Outcomes and Assessment Standards prescribed for the particular grade in Engineering Graphics and Design and group these according to natural and authentic links.

❷ Sequence the content.

Determine the order in which the groupings of Learning Outcomes and Assessment Standards will be presented in the particular grade in Engineering Graphics and Design. Besides the conceptual progression in the Assessment Standards for Engineering Graphics and Design, *context* can also be used to sequence groupings in Engineering Graphics and Design.

❸ Pace the content.

Determine how much time in the school year will be spent on each grouping of Learning Outcomes and Assessment Standards in the particular grade.

❹ Review forms of assessment.

Revisit the forms of assessment listed for the particular grade in the Subject Assessment Guidelines, and refine them to address each grouping of Learning Outcomes and Assessment Standards as developed in Step 1.

❺ Review LTSM.

Revisit the LTSM (resources) listed for the particular grade in the Subject Framework, and refine them to address each grouping of Learning Outcomes and Assessment Standards as developed in Step 1.

3.3.3 Designing Lesson Plans for Engineering Graphics and Design

Each grade-specific Work Schedule for ENGINEERING GRAPHICS AND DESIGN must be divided into units of deliverable learning experiences, that is, Lesson Plans. A Lesson Plan adds to the level of detail in the Work Schedule. It also indicates other relevant issues to be considered when teaching and assessing Engineering Graphics and Design.

A Lesson Plan is not equivalent to a subject period in the school timetable. Its duration is dictated by how long it takes to complete the coherent series of activities contained in it. See Appendix C for an example of a Lesson Plan for Engineering Graphics and Design.

❶ Indicate the content, context, Learning Outcomes and Assessment Standards.

Copy this information from the Work Schedule for the particular grade.

❷ Develop activities and select teaching method.

Decide how to teach the Learning Outcomes and Assessment Standards indicated in Step 1 and develop the activity or activities that will facilitate the development of the skills, knowledge and values in the particular grouping. Thereafter, determine the most suitable teaching method(s) for the activities and provide a description of how the learners will engage in each activity.

❸ Consider diversity.

Explore the various options available within each activity that will allow expanded opportunities to those learners that require individual support. The support provided must ultimately guide learners to develop the skills, knowledge and values indicated in the grouping of Learning Outcomes and Assessment Standards.

❹ Review assessment and LTSM.

Indicate the details of the assessment strategy and LTSM to be used in each activity.

❺ Allocate time.

Give an indication of how much time will be spent on each activity in the Lesson Plan.

3.3.4 Reflection and review of the Engineering Graphics and Design Learning Programme

After the Learning Programme has been delivered by means of Lesson Plans in the classroom, the teacher should reflect on what worked, how well it worked and what could be improved. Teachers need to note these while the experience is still fresh in their minds, so that if necessary, they can adapt and change the affected part of the Engineering Graphics and Design Learning Programme for future implementation. It is advisable to record this reflection on the Lesson Plan planning sheets.

APPENDIX A: CONTENT FRAMEWORK FOR ENGINEERING GRAPHICS AND DESIGN

Note:
See the Defining Content and Context document for Engineering Graphics and Design (Department of Education, 2006) for further guidance on the content to be addressed in Engineering Graphics and Design.

	Grade 10	Grade 11	Grade 12
Knowledge and application	SANS code of Practice: **0111** & **0143** related to Electrical, Civil and Mechanical drawings. **Principles of design**.	SANS code of Practice: **0111** & **0143** related to Electrical, Civil and Mechanical drawings. **Principles of design**.	SANS code of Practice: **0111** & **0143** related to Electrical, Civil and Mechanical drawings. **Principles of design**.
Knowledge and Skills	**Analyse** drawings and answer questions based on drawings within the context of: **civil, electrical, and mechanical.** **Dimensioning** (civil, architectural, mechanical) **Lettering** **Geometrical constructions** & polygons applied to civil, mechanical & electrical (hexagon, circle, octagon, triangle) **Freehand** drawing **Instrument** drawing **CAD** drawing Work on **grid** and **plain** paper	**Analyse** drawings and answer questions based on drawings within the context of: **civil, electrical, and mechanical.** **Dimensioning** (civil, architectural, mechanical) **Lettering** **Geometrical constructions** & polygons applied to civil, mechanical & electrical (division of line, circle through 3 pts, **Pythagoras**, Pentagon, division of circle) **Freehand** drawing **Instrument** drawing **CAD** drawing Work on grid and plain paper	**Analyse** drawings and answer questions based on drawings within the context of: **civil, electrical, and mechanical.** **Dimensioning** (civil, architectural, mechanical) **Lettering** **Geometrical** constructions & polygons applied to civil, mechanical & electrical (extension as necessary of Gr.10 & 11) **Freehand** drawing **Instrument** drawing **CAD** drawing Work on grid and plain paper
Terminology, concepts, functions and application	**Computer** hardware, operating systems, software and file types, file management **CAD software** **CAD drawing** and printing, templates, including layers Basic **CAD draw** and modify **functions**	**Computer peripherals** File association/import/export Customised Toolbars and templates Dimensions and dimension settings Object Linking and Embedding **CAD drawing** and **printing** templates, including layers and layouts All CAD **draw** and **modify** functions	CAD **utilities** and enquiries Profile settings for multiple users **3-axis drawings** Co-operative drawing (external references).

Knowledge of design cycle, skills of and application to civil, electrical, mechanical context	**Design** process Problem **identification**, **concept** sketches **Analysing** **Synthesising** **Working drawings** Evaluations (Model making where possible and appropriate)	**Design** process Problem **identification**, **concept** sketches **Analysing** **Synthesising** **Working drawings** Evaluations (Model making where possible and appropriate)	**Design** process Problem **identification**, **concept** sketches **Analysing** **Synthesising** **Working drawings** Evaluations (Model making where possible and appropriate)
Civil / Architectural Drawings which develop knowledge, understanding and skills	**Floor** plans **Sectioning** from foundation to floor level **Elevations** (top, north, south east/west) **Single** story dwellings & buildings (e.g. gabled or lean to, carports) 1st angle **orthographic** projection **Perspective** (1 & 2 pt) **True lengths** & **inclination** of lines (rabatment & generator of cone method) **Calculation** of quantities	**Floor** plans **Drainage** and **electrical details** on plans **Sectioning** from foundation to ceiling through door, windows, etc. **Elevations** (top, north, south east, west) **Single** & **double** story dwellings & buildings (e.g. gabled, lean to, thatched roofs) 1st angle orthographic projection **Perspective** (1 & 2 pt) **Calculation** of quantities **Notes** on drawings	**Floor** plans **Drainage** and **electrical details** on plans **Site** plans **Sectioning** from foundation to roof through door, windows, etc. **Roof truss** details, pitch, members, etc. (e.g. Howe, etc.) **Elevations** (top, north, south east, west) **Single** & **double** story dwellings & buildings – including split levels and on sloping ground. (e.g. gabled, lean to, thatched roofs, dormer windows, etc.) 1st angle orthographic projection **Perspective** (1 & 2 pt) **Calculation** of quantities **Notes** on drawings
Electrical / Electronics Drawings to develop knowledge, understanding and skills	Electronic **components** Circuit **symbols** & **diagrams** **Series** & **parallel** **Logics**: AND, OR	Electrical **fixtures** (symbols, e.g. light switch, socket, fluorescent, distribution board) for buildings & dwellings **Wiring diagrams**	Electrical **fixtures** (symbols, e.g. light switch, socket, fluorescent, distribution board) for buildings & dwellings **Wiring diagrams**

Mechanical Drawings which develop knowledge, understanding and skills	1st and 3rd angle **orthographic** projection **Pictorial** Isometric, oblique (single components such as individual parts of a machine, castings) Simple **assemblies** **Fasteners** (e.g. nut, bolt, washer, pins)	1st and 3rd angle **orthographic** projection **Assemblies** & **detail** drawings **Pictorial** Isometric (single **Components** such as individual parts of a machine, castings) **Fasteners** (e.g. spacer, keys, locknuts) **Loci**: helix (single start), Cam (roller & wedge follower) **Developments**. (e.g. containers, hoppers, basic transition pieces, e.g. square to square, rectangle to square, container covers/lids)- (implies true shape, true lengths as well as interpenetration lines)	1st and 3rd angle **orthographic** projection **Assemblies** & **detail** drawings **Components** of steel structures (e.g. beams, bolts, gussets, welding symbols, toe) **Pictorial** Isometric (single components such as individual parts of a machine, castings) **Fasteners** (e.g. spacer, keys, locknuts and extend) **Developments** to include seams and joints (e.g. containers, hoppers, complete transition pieces, e.g. square to round, rectangle to round, container covers/lids)- (implies true shape, true lengths as well as interpenetration lines) **Loci** of points on the components of mechanisms.

APPENDIX B: EXAMPLES OF ENGINEERING GRAPHICS AND DESIGN WORK SCHEDULES

ENGINEERING GRAPHICS AND DESIGN						
WORK SCHEDULE for GRADE 10						
TERM - 1						
GR.LO.AS	**TOPIC**	**ACTIVITIES**	**ASSESSMENT**	**DURATION IN HOURS**	**PLANNED START DATE**	**DATE COMPLETED**
10.1.2 10.1.3	Introduction to Engineering Graphics and Design.	Discuss the scope, educational and career opportunities related to Engineering Graphics and Design. Include human rights, gender, and inclusivity and HIV/AIDS issues.	Peer assessment Oral presentation	2		
10.1.3 10.3.1 10.3.2 10.3.5 10.4.2	Drawing principles according to SANS and related to basic civil, electrical and mechanical drawing.	Practice line types and lettering requirements according to the SANS Code of Practice and their application that include : outline, construction line, cutting plane line, hatching, hidden detail; centre line and lettering Set up a drawing sheet with borders, name block and title block.	Test based assessment	2		
	Free-hand drawing	Apply principles of free-hand drawing to reproduce and produce single, multi view and pictorial drawings using grid sheets and plain paper.	Presentation Drawing	3		
	Instrument Drawing	Instrument Drawing: Discuss and demonstrate the use and care of instruments. Produce scale drawings. (1:1, 1:2, 2:1, 1:5, 1:10, 1:100) Discuss, research and present in an appropriate form the dangers of the irresponsible use of sharp instruments	Application exercise Oral	1		
10.3.1 10.3.5 10.3.7 10.4.3 10.4.5	Orthographic projection	Orthographic projection: 1st and 3rd angle orthographic projection (Emphasis should be on 3rd angle).	Test based	6		
	Descriptive geometry	Determine the orthographic views of points and lines segments that are: perpendicular, inclined and oblique. Determine the true length of a line segment and the true inclination of a line segment to the HP and VP.	Presentation Drawing	6		
10.3.1 10.3.5 10.3.7 10.4.3 10.4.5	Solid geometry	Construct polygons. Draw orthographic views of solids incorporating geometrical shapes e.g. prisms, pyramids, cylinders, and cones. The axis of the solids could be perpendicular, parallel and inclined to one principal plane. Emphasis should be on 3rd angle.	Presentation Drawing	12		
			TOTAL HOURS	**32**		

TERM – 2						
10.3.1 10.3.5 10.4.3 10.4.5	Civil Drawing	Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower	Presentation Drawing	12		
	Electrical Drawing	Use given electrical and electronic component symbols to draw simple circuit diagrams.	Presentation Drawing	4		
	Mechanical Drawing	Draw simple objects from industry (e.g. castings, machine parts) Draw fasteners. Title, notes and symbol of projection.	Presentation Drawing	18		
10.3.2 10.4.4	Pictorial Drawing	Draw simple oblique drawings that include circles in the front view only relative to civil and mechanical (e.g. dwellings, machine components) Draw simple Isometric drawings including circles relative to civil and mechanical (e.g. dwellings, machine components). Produce simple 1-point perspective drawings relative to civil and mechanical. (e.g. dwellings, machine components)	Presentation Drawing	18		
			TOTAL HOURS	**52**		

TERM – 3						
10.3.6 10.4.3	Principles of Sectioning	Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	Presentation Drawing	18		
10.3.3 10.3.4	Computer technology	List the indigenous electronics and computer technologies that impact on graphical communication.	Application exercises	1		
10.4.1 10.4.2 10.4.3	Computer hardware	Computer hardware Terminology, concepts and functions of computer hardware (excluding the peripherals) Explain the functions and maintenance of computer hardware. Do printer hardware set up. Basic analysis of hardware for software compatibility. Monitor system resources. Apply skills to keyboard and mouse usage. Apply knowledge of the computer operating system.	Observation based	2		
	Computer Software	Identify and differentiate between software types (word processor, spreadsheet, database, paint and draw) and associated file types.	Identification	1		
	Basic File Management	Apply Cut, Copy, Paste, Zoom and other relevant functions. Demonstrate knowledge and understanding of computer viruses infection and prevention. Create/rename/delete files and directories Open existing files Start a document/drawing from scratch	Task evaluated at pre- determined stages	2		

	Overview of the CAD environment	Demonstrate knowledge of the theory of CAD software as applied to: The Menu System Toolbars (Standard, Object Properties, Draw, Modify and Dimension) Drawing Area (Background, Crosshairs, Coordinate System) Dialog boxes and windows Shortcut menus (Button Bars) The Command Line (where applicable) The Status Bar Different methods of zoom as used in CAD Select and erase objects.		1		
	Customisation	Set up of the drawing page and the printer, including scale settings. Set up units and drawing limits. Use orthographic constraints Snap to objects manually and automatically	Performance evaluation	1		
	CAD drawing	Produce drawings by using various coordinate input entry methods to draw straight lines. Apply various ways of drawing circles:		6		
	Annotating	Apply dimensions to objects. Apply annotations to drawings.		1		
	Layering	Set up and use of Layers: Use layers to create drawings Create, edit and use customised layers.	Presentation printout	1		
	Basic Modify Functions	Change line lengths through modifying existing lines (extend / lengthen)		1		
	Printing	Print documents to paper using the print command		1		
			TOTAL HOURS	**36**		

TERM – 4						
10.1.1 10.1.4 10.1.5 10.2.1 10.2.2 10.2.3 10.2.4 10.2.5 10.3.4	The Design process: Apply the design process in civil, electrical and mechanical context.	Design a dwelling according to given specifications from a given design brief. Produce a floor plan. Drawings to comply with all aspects of civil drawings for grade 10 (see above) Provide evidence that consideration was given to environmental issues and that the influence of indigenous knowledge systems was considered. Design a simple mechanical product according to given specifications. Drawings to comply with all aspects of mechanical drawings for grade 10 (see above) Discuss and give a report on entrepreneurial activities that could be developed through Engineering Graphics and Design. Include the following: Annotations, dimensions and scale. Concept sketches and notes on each stage. A final working drawing with all necessary constructions and calculations. All drawings must comply with the relevant and latest SANS code of practice.	Task based assessment Group Task Presentation Portfolio for Performance evaluation	18		
10.3.1 10.3.2 10.3.3 10.3.6 10.3.7 10.4.1	Visualisation cognitive and perceptual exercises	Analyse drawings and answer questions based on single, multi-view and pictorial drawings within the context of civil, electrical, and mechanical.	Test based assessment Analytical test	6		
			TOTAL HOURS	**24**		
			TOTAL HOURS FOR YEAR	**144**		

ENGINEERING GRAPHICS AND DESIGN						
WORK SCHEDULE for GRADE 11						
TERM – 1						
GR.LO.AS	**TOPIC**	**ACTIVITIES**	**ASSESSMENT**	**DURATION IN HOURS**	**PLANNED START DATE**	**DATE COMPLETED**
11.3.1 11.3.2 11.3.5 11.3.7 11.4.3 11.4.2	Single and Multi-view drawing principles and sectioning, using freehand and instruments	1st and 3rd angle orthographic projection techniques. Emphasis should be on 3rd angle. Apply to the following topics				
	Solid Geometry	Draw sectional views of composite right regular geometric solids and project the true shape of the sectioned surface.	Test based Presentation Drawing	16		
	Civil Drawing	Draw annotation, dimensioning and scale multi views of dwellings. Include floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Apply colour coding according to building drawing practice Draw sectional elevation showing foundation to ceiling	Test based Presentation Drawing	16		
	Single and Multi-view drawing principles and sectioning, using freehand and instruments	1st and 3rd angle orthographic projection techniques. Emphasis should be on 3rd angle. Apply to the following topics				
	Electrical Drawing	Draw parallel and series circuit diagrams that are relevant to: electrical appliances, house wiring, etc. Include notes where appropriate. Draw systems diagrams	Presentation Drawing	4		
			TOTAL HOURS	**36**		

TERM – 2						
11.3.1 11.3.2 11.3.5 11.3.7 11.4.3 11.4.2	Single and Multi-view drawing principles and sectioning, using freehand and instruments	1st and 3rd angle orthographic projection techniques. Emphasis should be on 3rd angle. Apply to the following topics				
	Mechanical Drawing	Draw simple assemblies that include fasteners (outside views as well as full, half and part sections). Include title, notes and symbols of projection. Draw detailed multi-view drawings from a given assembly.	Presentation Drawing	18		
	Interpenetration	Determine the line of intersection when two simple objects, profiles or solids penetrate or are joined.	Presentation Drawing	14		
	Development	Determine the surface development simple transition pieces and containers (excluding seam allowance)	Presentation Drawing	10		
			TOTAL HOURS	**42**		

TERM – 3						
11.3.2 11.4.4	Pictorial Drawing	Produce advanced isometric drawing from given information relative to civil and mechanical (e.g. dwellings, machine components) Produce advanced 1 and 2-point perspective drawings relative to civil and mechanical (e.g. dwellings, machine components).	Presentation Drawing	14		
11.3.6 11.4.3	Loci	Apply the principles of the helix and the cam to simple relevant civil and mechanical applications.	Presentation Drawing	10		
11.3.1 11.3.2 11.3.3 11.3.7 11.4.2 11.4.3 11.4.4	Computer technology	Discuss and list the global electronics and computer technologies that impact on graphical communication.	Observation based	.5		
	Hardware	Work with all computer peripherals, including networking components and digital devices	Application exercises	.5		
	Advanced File Management	Search/locate files on a computer or network. Move/copy files between directories. Convert files to different formats. Change file associations. Import/export/zip/unzip files	Application exercises	1		
	Customisation	Customise toolbars to increase workspace and to make access to buttons simpler. Set up drawing environment (drawing and printing templates) Start a drawing based on a template. Use wizards to help set up a drawing. Produce scaled templates with different layouts.	Task evaluated at predetermined stages	16		

	Layering	Use different view ports Set up and use of layers: -Set line thickness/ weight/ colour/ type -Create, edit and save customised layers. Use different layers for different objects or line types.	Performance evaluation			
	Dimensions and Annotations	Learn to customise dimension settings according to SANS Apply dimensions to objects. Apply annotations to drawings including special symbols.				
	Hatching Guide lines	Hatch object using different conventions Use geometry lines or construction lines to create drawings.				
	Drawing Techniques and Principles	Use offset lines or multi lines. Demonstrate knowledge and understanding of specific 2d projection techniques and principles used to produce computer drawings. Differentiate between CAD and instrument drawing techniques.				
	Drawing Functions	Construct ellipses Construct polygons either inscribed or circumscribed to a circle. Create Point Objects - Use point, measure and divide functions. Use the Spline function to create objects such as contours, cams and spirals.				
	Snaps	Use all snap methods, including tracking				
	Modify Functions	Create arcs using Trim, Arc and Fillet commands. Apply grips to manipulate objects. Use the Chamfer command Use the Move, Copy, Scale and Stretch commands.				
	Object linking and embedding (OLE)	Link drawings to other windows applications. Add text, graphs and tables from other software programs into drawings. Insert bitmaps into CAD software from a raster source				
	Customised objects	Add own symbols (blocks) into a library Apply advanced techniques to lay out multiple drawings or views of a single drawing.				
	Printing layouts	Enhance prints by combining with rasters.	Printout			
			TOTAL HOURS	**42**		

TERM – 4						
11.1.1 11.1.2 11.1.3 11.1.4 11.1.5 11.2.1 11.2.2 11.2.3 11.2.4 11.2.5 11.3.4	The Design process: Apply the design process in civil, electrical and mechanical context.	Interpret the given information, formulate a design brief, determine specifications: Produce a floor plan. Provide multi view drawings. Drawings to comply with all aspects of civil drawings for grade 11 (see above) Compare and report on the contributions that global cultures have had in developing Engineering Graphics and Design and how indigenous knowledge has been modified when combined with global knowledge systems to suit modern living. Discuss and report the inter-relationship and responsibility that exists between Engineering Graphics and Design, society and the environment. The importance of practicing sustainable and environmentally friendly practices and the necessity to cater for people with disabilities.	Group Task	9		
		Design an advanced mechanical device. Render drawings, show surface treatments. Drawings to comply with all aspects of mechanical drawings for grade 11 (see above) Discuss and give a report on the impact of HIV/AIDS on the environment and society. Discuss and report on the competencies an entrepreneur should have in order to follow a career in Engineering Graphics and Design. Analyse the gender bias in light of competencies to Engineering Graphics and Design.	Presentation Portfolio for performance evaluation	9		
		Include the following: Annotations, dimensions and scale. Concept sketches and notes on each stage. A final working drawing with all necessary constructions and calculations. All drawings must comply with the relevant and latest SANS code of practice.				
11.3.1 11.3.2 11.3.3 11.3.4 11.3.6 11.3.7 11.4.1	Visualisation cognitive and perceptual exercises	Visualisation cognitive and perceptual exercises Analyse drawings and answer questions based on single, multi-view and pictorial drawings within the context of civil, electrical, and mechanical.	Test based Analytical test	6		
			TOTAL HOURS	**24**		
			TOTAL HOURS FOR YEAR	**144**		

ENGINEERING GRAPHICS AND DESIGN						
WORK SCHEDULE for GRADE 12						
TERM – 1						
GR.LO.AS	**TOPIC**	**ACTIVITIES**	**ASSESSMENT**	**DURATION IN HOURS**	**PLANNED START DATE**	**DATE COMPLETED**
12.3.1 12.3.2 12.3.5 12.3.7 12.4.2 12.4.3	Single and Multi-view drawing principles and sectioning, using freehand and instruments	1st and 3rd angle orthographic projection techniques. Emphasis should be on 3rd angle. Apply to the following topics:				
	Civil Drawing	Produce annotation, dimensioning and scale multi view working drawings of dwellings. Include floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Apply colour coding according to building drawing practice. Draw sectional elevation showing foundation to ceiling. Show site plan and schedule of specifications. Include electrical, plumbing and drainage detail.	Presentation Drawing	15		
	Electrical Drawing	Draw wiring diagrams on floor plans of buildings. Represent these as circuit diagrams. Draw block diagrams	Presentation Drawing	4		
	Mechanical Drawing	Draw complex assemblies that include fasteners (outside views as well as full, half and part sections). Draw detailed multi-view drawings from assemblies. Include Title, notes and symbols of projection. Insert welding symbols, machining symbols, surface treatment relative to steel work.	Presentation Drawing	15		
			TOTAL HOURS	**34**		

TERM – 2						
12.3.1 12.3.2 12.3.5 12.3.7 12.4.2 12.4.3	Interpenetration	Determine the line of intersection when two advanced objects, profiles or solids penetrate or are joined (e.g. cornices, pipes, etc.).	Presentation Drawing	10		
	Development	Determine the surface development of advanced transition pieces and containers (excluding seam allowance).	Presentation Drawing	10		
12.3.6 12.4.3	Loci	Apply the principles of the loci of points on the components of mechanisms. Apply the principles of the helix and the cam to advanced relevant civil and mechanical applications.	Presentation Drawing	12		
12.3.2 12.4.4	Pictorial	Produce a sectioned isometric drawing from given information relative to civil and mechanical (e.g. dwellings, machine components). Draw complex two point perspective drawings of buildings relative to civil and mechanical (e.g. dwellings, machine components)	Presentation Drawing	12		
			TOTAL HOURS	**44**		

TERM – 3						
12.3.1 12.3.2 12.3.3 12.3.5 12.3.7 12.4.2 12.4.3 12.4.4	Computer Technology.	Evaluate the advantages and disadvantages of indigenous and global electronics and computer technologies that impact on graphical communication.	Observation based assessment	17		
	Profiles and System Variables.	Customizing the drawing environment for multiple users according to individual work preferences.	Application exercises			
	Special functions.	Apply the Utility functions and make Enquiries				
	Drawing Techniques and Principles. UCS / 3-axis xyz wire frame.	Demonstrate knowledge and understanding of specific 3D–projection techniques and principles used to produce 3-axis computer drawings. Create various types of poly lines Convert lines to poly lines Set the Coordinate System to enable 3D drawing. Make use of different techniques to set the Coordinate System Draw 3-dimensional in wire frame mode.	Task evaluated at predetermined stages			
	Principles of Dimensioning	Customise dimension settings and apply dimensions to objects.	Performance evaluation			
	Annotations	Apply annotations to drawings.				

	Co-Operative Drawing.	Link up with other users on a network and doing co-operative drawing assemblies	Presentation printout			
	Scale printing	Drawing full scale and scaling down the print itself				
	Layout printing	Designing drawings with multiple layout options Print Layouts				
12.1.1 12.1.2 12.1.3 12.1.4 12.1.5 12.2.1 12.2.2 12.2.3 12.2.4 12.2.5 12.3.4 12.4.3	The Design process: Apply the design process in civil, electrical and mechanical context	Perform a needs analysis then formulate a design brief through collectively and or collaboratively analysing given information:		17		
		Design a building. Show all electrical and plumbing symbols and details. Project necessary elevations and a sectional elevation showing the foundations to the roof. Drawings to comply with all aspects of civil drawings for grades 10 &11 (see above)	Task based Group Task Presentation Portfolio for performance evaluation			
		Design a complex mechanical device. Render drawings, show surface treatments. Drawings to comply with all aspects of mechanical drawings for grades 10 &11 (see above)				
		Formulate a report on the inter-relationship and responsibility that exists between Engineering Graphics and design, society and the environment. The organisations that need to be contacted should companies or individuals be found not exercising sustainable and environmentally friendly practices. Investigate and formulate a report on ways in which Engineering Graphics and design can contribute towards the campaign against the spread of HIV/AIDS and other infectious				
		Evaluate and report on the contributions that indigenous and global cultural knowledge systems have had on Engineering Graphics and design and how they may be further developed in the future.				
		Present in various ways the possible entrepreneurial opportunities open to Engineering Graphics and design learners.				
		Include the following: -Annotations, dimensions and scale. -Concept sketches and notes on each stage. -A final working drawing with all necessary constructions and calculations. All drawings must comply with the relevant and latest SANS code of practice.				
			TOTAL HOURS	**34**		

TERM – 4						
12.2.4 12.3.1 12.3.2 12.3.6 12.3.7	Visualisation cognitive and perceptual exercises	Visualisation cognitive and perceptual exercises Analyse drawings and answer questions based on single, multi-view and pictorial drawings within the context of, civil, electrical, and mechanical.	Test based assessment Analytical test	4		
LO1 – LO4		Finalise the Practical Assessment Task	Presentation of product Practical modelling	8		
LO1 – LO4	**REVISION**			12		
	NSC EXAMINATION			16		
			TOTAL HOURS	**40**		
			TOTAL HOURS FOR YEAR	**152**		

APPENDIX C: EXAMPLE OF A LESSON PLAN FOR ENGINEERING GRAPHICS AND DESIGN

ENGINEERING GRAPHICS AND DESIGN	GRADE: 10 CLASS…….	DURATION: 4½ HOURS
Core Knowledge Area: **Pictorial Drawing** **Content:** Simple oblique drawings. Include circles in the front view only. **Context:** Mechanical Technology: Castings	**Learning Outcomes and Assessment Standards** **LO 3:** We know this when the learner can demonstrate knowledge and understanding of the principles of projection with respect to pictorial drawings. **LO 4:** We know this when the learner can use instruments and apply the principles of oblique drawing.	

Concepts	Teaching Strategy		Resources	Evidence of Achievement	Assessment Strategy		Time frame
	Teacher Activity	Learner Activity			Method	Tools	
Oblique drawing; Cabinet method; Visualization	1. Introduce the concept of oblique drawing with a model or casting without circles	Complete worksheet by converting from isometric or orthographic projection to oblique.	Chalkboard; Models; Drawing board and instruments; A4 Drawing sheet; Worksheets	Teacher lead discussion Learner produces oblique drawings.	Peer/ self	Answer on chalk board, OHP	1½ hours
Drawing circles and centre lines.	2. Introduce castings with circle on front surface only.	Complete worksheet from isometric/ orthographic to oblique.	A4 Drawing sheet, Worksheets	Learner produces oblique drawings.	Teacher	Correct with mask	1 hour
Drawing circles set back	3. Introduce castings with circle set back from front surface.	Complete worksheet from orthographic to oblique.	A4 Drawing sheet, Worksheets	Learner produces oblique drawings.	Teacher	Correct with mask	1 hour
Assessment	Invigilate and assess.	Test	A4 Drawing sheet, test	Learner produces oblique drawing in a test	Teacher	Correct with mask and mark to rubric	1 hour

Expanded opportunities
Enrichment: More complex shaped castings.
Remedial: Identify individual problems and give supplementary exercises.