



# **NATIONAL CERTIFICATE (VOCATIONAL)**

## **SUBJECT GUIDELINES**

# **ENGINEERING GRAPHICS AND DESIGN (CAD)**

## **NQF Level 3**

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# **ENGINEERING GRAPHICS AND DESIGN (CAD) – LEVEL 3**

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## INTRODUCTION

### **A. What is Engineering Graphics and Design (CAD)?**

The subject deals with the drawing language, developments, projections, first-angle and third-angle orthographic projection drawings of single objects, assembling drawings and detail drawings, freehand sketches, isometric drawing, oblique drawings, computer environment for scale production drawings using a CAD programme, printing CAD scale production drawings, and management of files.

### **B. Why is Engineering Graphics and Design (CAD) important in the Manufacturing, Engineering and Technology programme?**

Drawing is the language of communication that is widely used and understood in Engineering. The thoughts about goods to be manufactured and constructions to be made are expressed in the form of drawings and graphics before the actual work on the project starts. The understanding and interpretation of drawings and graphics is crucial in the engineering world of work.

### **C. The link between the Engineering Graphics and Design (CAD) Learning Outcomes and the Critical and Development Outcomes**

- The subject improves students' problem solving skills through the use of technology, by constructing and developing comprehensive drawings of components.
- It enhances ethical behaviour of students because they learn to adhere to the prescribed code of engineering drawing.

### **D. Factors that contribute in the Engineering Graphics and Design Learning Outcomes.**

- A classroom equipped with drawing tables and chairs and other drawing equipment.
- A centre with computers loaded with the relevant software, and plotters.
- Qualified and competent facilitators, educators and assessors who not only aid and facilitate teaching, training and learning but who are readily available to provide moral support.
- A student who is patient, disciplined and works well in a team.
- A student who is a critical thinker and efficient problem- solver who can readily evaluate data systems and processes.

## 1 DURATION AND TUITION TIME

This is a one year instructional programme comprising 200 teaching and learning hours. The subject may be offered on a part-time basis provided the candidate all of the assessment requirements.

Course preparation should consider students with special educational needs.

## 2 SUBJECT LEVEL FOCUS

Interpret and produce engineering drawings, maps, graphics, sketches and computer-aided drawings (CAD).

## 3 ASSESSMENT REQUIREMENTS

### 3.1 Internal assessment (50 percent)

#### 3.1.1 Theoretical Component

The theoretical component will form 40 percent of the internal assessment.

Internal assessment of the theoretical component of Engineering Graphics and Design (CAD) Level 3 will take the form of observations, class questions, group work, individual discussions with students, class and semester tests, internal examinations. Daily observation can be done when marking exercises of the previous day and class questions.

Assignments, case studies and tests can be given at the end of a topic, and must form part of the internal assessment.

#### 3.1.2 Practical Component

Practical components include applications and exercises. All practical work must be indicated in the Portfolio of Evidence (PoE).

The practical component will form 60 percent of internal assessment.

Internal assessment of practical component of Engineering Graphics and Design Level 3 will take the form of assignments, practical demonstrations, case studies, practical examinations in a simulated engineering work environment.

Students may complete practical exercises on a daily basis. Assignments and case studies can be done at the end of a topic. Practical examinations form part of internal practical assessment.

- **Some examples of practical assessments include, but are not limited to:**
- Presentations (lectures, demonstrations, group discussions and activities, practical work, observation, role play, independent activity, synthesis and evaluation).
- Exhibitions by students
- Visits undertaken by students based on a structured assignment task
- Research
- Task performance in a simulated/structured environment

- **Definition of the term “Structured Environment”**

“Structured environment” for the purpose of assessment refers to an actual or simulated workplace or workshop environment. It is advised that a practicum room is available on each campus for practical assessment

- **Evidence in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the students' Portfolio of Evidence (PoE). The tools and instruments constructed and used for the purpose of conducting such assessments must be clear from evidence contained in the PoE.

### 3.1.3 Processing of internal assessment mark for the year

A year mark out of 100 is calculated by adding the marks of the theoretical component and the practical component of the internal continuous assessment.

### 3.1.4 Moderation of internal assessment mark

Internal assessment is subject to internal and external moderation procedures as contained in the *National Examinations Policy for FET College Programmes*.

## **3.2 External assessment (50 percent)**

A national examination is conducted annually in October or November by means of a paper set, marked and moderated externally.

Details in respect of external assessment are contained in the *Assessment Guidelines: Engineering Graphics and Design (CAD)* (Level 3).

## **4 WEIGHTED VALUES OF THE TOPICS**

| TOPICS/TOPICS                        | WEIGHTED VALUE |
|--------------------------------------|----------------|
| 1. Isometric drawings                | 10%            |
| 2. Assembly drawings                 | 25%            |
| 3. Detailed drawings                 | 25%            |
| 4. Development and inter-penetration | 15%            |
| 5. Computer Aided Design             | 25%            |
| <b>TOTAL</b>                         | <b>100</b>     |

## **5 CALCULATION OF FINAL MARK**

Continuous Assessment: Student's mark/100 x 50/1 = a mark out of 50 (a)

Theoretical Examination Mark: Student's mark/100 x 50/1 = a mark out of 50 (b)

**Final Mark: (a) + (b) = a mark out of 100**

All marks are systematically processed and accurately recorded to be available as hard copy evidence for, amongst others, purposes of moderation and verification.

## **6 PASS REQUIREMENTS**

The student must obtain at least fifty (50) percent in ICASS and fifty (50) percent in the examination.

## **7 SUBJECT AND LEARNING OUTCOMES**

On completion of Engineering Graphics and Design (CAD) Level 3 the student should have covered the following topics:

- Topic 1: Isometric drawings
- Topic 2: Assembly drawings
- Topic 3: Detailed drawings
- Topic 4: Development and inter-penetration
- Topic 5: Computer Aided Design

## 7.1 Topic 1: Isometric drawings

**7.1.1 Subject Outcome:** Construct an isometric scale to be used in isometric drawings.

**Learning Outcome:**

- Explain what an isometric scale is.
- Explain how and isometric scale is used to construct isometric drawings.
- Plan the drawing paper to maximise page usage.
- Use engineering drawing equipment to produce an isometric scale.

*Range: Triangles, flexi curves, drawing sets, different pencils, rubber, dusters, scale ruler, T square.*

**7.1.2 Subject Outcome 2:** Construct an isometric drawing.

**Learning Outcome:**

- Differentiate between first and third angle isometric drawings.
- Use the four-centre method to construct an ellipse.
- Use engineering drawings techniques to produce 3-dimensional drawings in first angle projection.
- Use engineering drawing techniques to produce 3-dimensional drawings in third angle projection.

## 7.2 Topic 2: Assembly Drawing

**7.2.1 Subject Outcome 1:** Perform sectioning on engineering drawings using different methods.

**Learning Outcome:**

- Identify different methods of sectioning.
- Section engineering drawings using the correct techniques.

*Range: Techniques refers but not limited to 30 degrees, 45 degrees, 60 degrees, staggered and scrap sectioning.*

**7.2.2. Subject Outcome 2:** Perform engineering drawing assemblies.

**Learning Outcome:**

- Assemble different parts to form one single drawing in first angle orthographic projection.
- Assemble different parts to form one single drawing in third angle orthographic projection.
- Section the assembled drawing according to the given instruction.
- Label the different parts of the assembled drawing.

## 7.3 Topic 3: Detailed Drawings

**7.3.1 Subject Outcome 1:** Perform dimensioning to a given drawing using the correct methods.

**Learning Outcome:**

- Explain different dimensioning methods.
- Draw and insert dimensions according to the drawing code of standard to a given drawing.

**7.3.2 Subject Outcome 2:** Produce detailed drawings from the given assemblies

**Learning Outcome:**

- Identify and separate parts from an assembled drawing.
- Produce detailed drawing in first angle orthographic projection.
- Produce detailed drawing in third angle orthographic projection.
- Dimension the drawings using the correct techniques.
- Section the drawing according to the given instruction.

## 7.4 Topic 4: Development and inter-penetration

### 7.4.1 Subject Outcome 1: Developing by parallel line method.

#### Learning Outcome:

- Identify, explain and select this method in the relevant context.
- Neatly draw parallel lines on template paper, using appropriate scales to indicate the equal divisions of the object to be developed.
- Calculate all relevant data such as angles, heights, diameters and circumferences.
- Use the principles of line projections to produce the final template.

### 7.4.2 Subject Outcome 2: Developing by radial line method.

#### Learning Outcome:

- Identify, explain and select this method in the relevant context.
- Neatly draw radial lines on template paper, using appropriate scales to indicate the equal divisions of the object to be developed.
- Calculate all relevant data such as angles, heights, diameters and circumferences.
- Use the principles of line projections and stepping-off to produce the final template.

### 7.4.3 Subject Outcome 3: Developing by using triangulation.

#### Learning Outcome:

- Identify, explain and select this method in the relevant context.
- Explain the functions of bend lines.
- Explain the meaning of true length lines.
- Understand and apply the theorem of Pythagoras when calculating bend lines.
- Transfer top view measurements into true length measurements.
- Use the principles of triangulation to produce the final template.

## 7.5 Topic 5: Computer Aided Design (CAD)

### 7.5.1 Subject Outcome 1: Prepare the computer environment, and plan CAD scale production drawings.

#### Learning Outcome:

- Select CAD programme to suit the task.
- Select size, scale and orientation of drawing on a newly created document to suit the task.

### 7.5.2 Subject Outcome 2: Produce scale production drawings to line stage using a CAD program.

#### Learning Outcome:

- Project elevation outlines in accordance with final design.
- Position elevation outlines in accordance with orthographic principles.
- Project details of views complete in accordance with final design.

*Range: Examples are multi-view orthographic drawing including full, part, aligned and removed sections; fully detailed and dimensioned drawing with conventional symbols.*

### 7.5.3 Subject Outcome 3: Complete and verify CAD scale production drawings.

#### Learning Outcome:

- Title the production drawing to meet standards convention
- Title the production to meet site requirements in terms of typography
- Title the production drawing for processing or manufacturing data
- Save drawings to file according to site procedures.

**7.5.4 Subject Outcome 4:** Print CAD scale production drawings and manage files.

**Learning outcome:**

- Select paper size, orientation, and scale and printer type to meet task and site requirements.
- Print copy to meet task and site requirements.
- Verify copy to meet task and site requirements.
- Correct copy as necessary to meet task and site requirements.

## **8 RESOURCE NEEDS FOR THE TEACHING OF ENGINEERING GRAPHICS AND DESIGN (CAD) - LEVEL3**

### **8.1 Human Resources**

The educator for Engineering Graphics and Design (CAD) level 3 must be:

- A subject matter expert
- Competent lecturer
- Certificated as an assessor with ETDP SETA
- Registered with an ETQA or SETA
- A life-long student
- In possession of an NQF level 5 teaching qualification
- Conversant with OBE methodologies
- Instructor qualified in the field of study
- Have skills in facilitating learning programmes development
- A trade test will be an added advantage

It is of paramount importance that educators working in this environment attend seminars and upgrading workshops in order to be updated and re-skilled with the latest developments in technology

### **8.2 Physical Resources**

- Store room for consumables
- Lecture room(s) equipped with:
  - Drawing tables (adjustable height and mounted with drawing equipment recommended).
  - Drawing room chairs (adjustable height recommended).
- A computer room with data projector, printers and plotters (latest technology recommended) and appropriate computer software
- Ablution facilities

### **8.3 Other Resources**

- Funds, from learning provider or funding bodies for the procurement of consumables tools and equipment be readily made available for the effective operation of a workplace involved in a training programme and students individually equipped with necessary tools.

### **8.4 Learning and teaching materials**

Learning materials must conform to approved training and industrial standard requirements and articulate to Higher Education.

The following zones should be considered in augmenting the learning material:

- Academic
- Practical

#### **• Academic**

Academic resources required to be in place in this field of learning are:

- Literature necessary to address the tasks in the learning material fully
- Computer literacy
- Learning materials using projection equipment
- Promotion of researching information
- Educational tours to relevant learning venues
- Educational and motivational talks from industry
- Visual and audio-visual material.

#### **• Practical**

- Workshop manuals and documentation for the theoretical knowledge.
- Models and demonstrations