education

Department:
Education
REPUBLIC OF SOUTH AFRICA

# NATIONAL CERTIFICATE (VOCATIONAL)

## SUBJECT GUIDELINES

# MATERIALS TECHNOLOGY

# NQF Level 3

September 2007

# MATERIALS TECHNOLOGY – LEVEL 3

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# INTRODUCTION

## A. What is Materials Technology?

Materials Technology introduces students to the materials commonly used for components in the mechanical engineering field, capable of withstanding stresses that allow for innovative engineering design. Properties of the materials, processes used for working with them and their applications are the focus.

## B. Why is Materials Technology important in the Mechanical Engineering programme?

In Materials Technology students become aware of the characteristics and uses of different materials that are important in mechanical engineering, and the processes for working with them.

- Materials used within the Mechanical Engineering, but not limited to metals, ferrous metals, non-ferrous metals, rubber, plastics, textile, wood etc.
- Material identification, types, selection, use, processing, characteristics and testing. Laboratory/experimental work. Knowledge of the effect that external factors have various materials.

## C. The link between the Materials Technology Learning Outcomes and the critical and development outcomes.

At this level the Learning Outcomes improve student experience and understanding by increasing knowledge through the application of specific subject matter, thereby developing student self-confidence for further technological advancement.

- Identify and solve problems in which responses display that responsible decisions have been made using critical and creative thinking.
- Recognize hazards defects and respond appropriately.
- Organize and manage oneself and one's activities responsibly and effectively.
- Collect, analyse, organize and critically evaluate information.
- Demonstrate understanding of Materials Technology in the manufacturing process.

## D. Factors that contribute to achieving the Materials Technology Learning Outcomes

- A workshop or storeroom equipped with all the important metals required for the subject.
- A student who has an interest in physical science and chemistry would be an advantage.

## 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 all of the assessment requirements set out hereunder are adhered to.

Students with special education needs (LSEN) must be catered for in a way that eliminates barriers to learning.

## 2 SUBJECT LEVEL FOCUS

- Describe the properties and characteristics of materials used in mechanical engineering.
- Explain processes used in manufacturing of metal
- Explain and use testing procedures to evaluate properties of materials

## 3 ASSESSMENT REQUIREMENTS

### 3.1 Internal assessment (50 percent)

3.1.1 Theoretical Component

The theoretical component will form 40 percent of internal assessment.

Internal assessment of the theoretical component of Materials Technology Level 3 will take the form of observation, class question, group work, individual discussion with students, topic and semester tests, internal examinations. Observation can be done on completion of work piece.

Assignments case studies and tests can be done at the end of a topic. Tests and internal examinations must form part of internal assessment.

3.1.2 Practical Component

The practical component includes applications and exercises. All practical work must be indicated in a Portfolio of evidence (PoE).

The practical component will form 60 percent part of internal assessment.

Internal assessment of the practical component of Materials Technology Level 3 will take the form of assignments practical exercises, practical examination in a workshop environment. Students may complete practical exercises on a daily basis. Assignments can be done at the end of a topic. The practical examination can form part of internal practical assessment

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- **Some examples of practical assessments include, but are not limited to:**
  - Presentations (lectures, demonstrations, group discussions and activities, practical work, observation, role play, self activity, judging and evaluation).
  - Use of aids
  - Exhibitions
  - Visits
  - Research
  - Tests and Assignments
  - Structured Environment

- **Definition of the term "Structured Environment"**

"Structured environment" for the purposes of assessment refers to an actual or simulated workplace, or workshop environment.

Evidence of this practical component must be provided in the form of a Logbook with a clear listing of the competencies to be assessed. The following information must be contained in the logbook, which must form part of the PoE.

- Index of competencies as set out in Learning Outcomes and Assessment Standards;
- Evidence of Learning Outcomes achieved by students;
- Evidence of assessment of Learning Outcomes by an accredited assessor
- Record of time spent on each activity
- Signature of student
- Recommendations of Facilitator

For the logbook to be regarded as valid evidence, it must be signed off by an officially assigned supervisor.

- **Evidence in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the students' Portfolio of Evidence. 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 subjected to both internal and external moderation procedures as set out 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(s) set and moderated externally.

External assessment details are set out in the *Assessment Guidelines: Materials Technology* (Level 3).

## 4 WEIGHTED VALUES OF THE TOPICS

| TOPICS/TOPICS | WEIGHTED VALUE |
|---|---|
| 1. Metals | 25% |
| 2. Non Metals | 25% |
| 3. Metal Processing | 25% |
| 4. Material testing | 25% |
| **TOTAL** | **100** |

## 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 Materials Technology Level 3 the student should have covered the following topics:

Topic 1: Metals
Topic 2: Non-Metals
Topic 3: Metals Processing
Topic 4: Materials Testing

### 7.1 Topic 1: Metals

**7.1.1 Subject Outcome:** Explain ferrous metals, their composition and characteristics.

**Learning Outcome:**

- Differentiate between different ferrous metals according to the characteristics.
  *Range: Malleability, ductility, compressive and tensile strength.*
- Classify the types and grades of ferrous metals in terms of physical properties.
- Explain the effect of carbon structure on ferrous metals.
- Discuss the effect of carbon percentage on ferrous metals.

**7.1.2 Subject Outcome 2:** Explain non-ferrous metals and their composition characteristics.

**Learning Outcome:**

- Describe the characteristics of non-ferrous metals.
  *Range: Malleability, torsion, compressive strength etc.*
- Classify types and grades of non-ferrous metals.
- Describe the fabrication process of non-ferrous metals.
- Explain the uses and importance of non-ferrous metals in the industry.
- Discuss the metallurgical implications of the metals.

**7.1.3 Subject Outcome 3:** Describe the benefits of alloying elements in metal.

*Range: Manganese, copper, tin, magnesium.*

**Learning Outcome:**

- Identify the reasons foralloying.
- Describe the physical property effect of alloying.
- Explain how alloying of metals affects machining processes.

  *Range: Tools and equipment used, period of time of machining, cutter speed, cutting tools and tolerances.*

### 7.2 Topic 2: Non-Metals

**7.2.1 Subject Outcome 1:** Explain the types and applications of non-metals.

*Range: Glass fibre, boron thermosetting plastics, chemical setting plastics*

**Learning Outcome:**

- Explain the characteristics of non-metals.
  *Range: bending, brittleness, heat temperature etc.*
- Categorise the types of non-metals.
- Describe the most common applications of non-metals and reasons for using these.

### 7.3 Topic 3: Metal Processing

**7.3.1 Subject Outcome 1:** Describe the various processes of manufacturing steel.

**Learning Outcome:**

- Describe the working principles of a cupola furnace.
- Describe the working principles of an arc furnace.
- Describe the working principles of converters.
  *Range: rotor, EFCO (electrical furnace)*

**7.3.2 Subject Outcome 2:** Identify the differences in ferrous metal processing.

**Learning Outcome:**

- List advantages and disadvantages of the various processing techniques:
  *Range: A cupola furnace, an arc furnace, a Bessemer converter*

**7.3.3 Subject Outcome 3:** Demonstrate knowledge of heat treatment.

**Learning Outcome:**

- Explain the hardening of materials through heat application.
  *Range: Annealing and its metallurgical effect, normalizing and its metallurgical effect.*
- Explain tempering and its purpose.
- Analyse the controlling of atmosphere to bring about metallurgical changes (carburising).

### 7.4 Topic 4: Materials Processing

**7.4.1 Subject Outcome 1:** Evaluate properties of materials through testing.

**Learning Outcome:**

- Determine the hardness of material.
- Conduct a bending test.
- Conduct torsion strength testing.
- Conduct a tensional test.
- Conduct a compressive test.
- Conduct a shear test.

**7.4.2 Subject Outcome 2:** Interpret testing results.

**Learning Outcome:**

- Analyse results according to International standards.
- Draw up a report on the testing results.

## 8 RESOURCE NEEDS FOR THE TEACHING OF MATERIALS TECHNOLOGY LEVEL 3

### 8.1 Human Resources

The educator for Materials Technology Level 3 must be:

- A subject matter expert
- Certificated as an assessor with ETDP SETA
- Registered with an ETQA or SETA
- Preferably in possession of an NQF Level 5 teaching qualification
- Conversant with OBE methodologies
- 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 in the latest technological developments.

### Physical Resources

Building must be appropriately designed for workshop type with relevant safety mechanisms in place. Building structure should comply with the following requirements:

- Store room-consumables
- Tool room
- Spray room
- Lecture room(s)
- Training area-work area
- Ablution facilities

To cater for heavy consumables the storeroom must be equipped with mechanical lifting devices suitable for storage purpose.