



education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

SOIL SCIENCE

NQF Level 3

September 2007

SOIL SCIENCE – LEVEL 3

CONTENTS

INTRODUCTION

1 DURATION AND TUITION TIME

2 SUBJECT LEVEL FOCUS

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment

3.2 External assessment

4 WEIGHTED VALUES OF TOPICS

5 CALCULATION OF FINAL MARK

6 PASS REQUIREMENTS

7 SUBJECT AND LEARNING OUTCOMES

7.1 Fertilization of soils

7.2 Soil, water and evapotranspiration

7.3 Soil erosion and its prevention

8 RESOURCE NEEDS FOR THE TEACHING OF PRIMARY AGRICULTURE

8.1 Phased development of training and demonstration farm

8.2 Resource needs training and demonstration

INTRODUCTION

A. What is Soil Science?

The National Certificates (Vocational) extend from NQF Levels 2 to 4 in Further Education and Training Colleges. Soil Science (Level 3) followed by Farm Planning and Mechanisation (Level 4), are Vocational subjects in the Primary Agriculture programme of the National Certificates (Vocational). The subject Soil Science covers the following fields of study:

- Some aspects of atoms and molecules (enabling students to understand concepts not only in Soil Science but also in Animal Production and Plant Production.)
- Soils and their components
- Plants' requirements to grow from soils
- Fertilisation of soils
- Soil water and evapo-transpiration
- Soil erosion and its prevention
- Planning an agricultural enterprise
- Agricultural mechanisation

The subject aims to equip students with skills, values and knowledge necessary to progress through the levels of the National Certificates (Vocational). Whilst the subject is grounded in the South African context, it also incorporates global small-scale farming imperatives.

B. Why is Soil Science important in the Primary Agriculture programme?

The Primary Agriculture programme is designed to equip learners with the necessary skills to enter a mixed farming situation. Soils and their successful management are central to understanding and successfully practising improved agricultural techniques. Planning an enterprise and using farm machinery successfully are similarly important. Recordkeeping and financial management are covered in the separate subject, Agri-business.

C. The link between the Soil Science Learning Outcomes and the Critical and Developmental Outcomes

The methods of teaching and assessment are vital for the achievement of the Critical Outcomes and Developmental Outcomes. During the three years of the National Certificates (Vocational) programme, students are responsible, individually and in groups, for live animals and crops, and consequently, keep journals in which they answer, amongst others, reflective questions.

The assessment questions will require students to go beyond mere recall and into solving problems that relate to soils and the other topics linked to their practical work by asking "What if...?" and similar questions. Questions relating to the planning of farm activities can be used to promote in-depth thinking.

Given these teaching and assessment processes, by the end of the three years the students should have covered all seven Critical Outcomes to some extent and most if not all of the Developmental Outcomes. Critical thinking, critical evaluation and seeing the world as a set of interrelated systems will be easier to address by the third year of the programme, when the students are at NQF level 4 and have more information available and are able to consider a wider range of options.

D. Factors that contribute to achieving the Soil Science Learning Outcomes

- Enabling environment – This subject should be presented in the context of small, micro and medium enterprises (SMMEs), emerging small-scale farmers and personal needs.
- Resources – Students should have access to all the necessary resources. For Topic 1 at Level 2 (Basic Aspects of Atoms and Molecules) a well-equipped school chemistry laboratory, with additional equipment for determining soil texture and measuring pH using both laboratory and field methods, would suffice. Practical field work with soils is likely to be done in the same locations as for Plant Production. For agricultural mechanisation at Level 4, it may be necessary to negotiate access to other locations having relevant farm machinery, though colleges presenting the National Certificates (Vocational) Primary Agriculture programme should have a tractor, plough and soil cultivation equipment available for student use.
- Experiential exposure – Students should be exposed to real work and simulated work environments.
- Suitably qualified lecturers – Lecturers should have a solid command of subject knowledge and skills, and be well informed about legislation, community issues and accessing support systems, for example systems provided by the Department of Agriculture

1 DURATION AND TUITION TIME

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

- Apply soil science to the production of plants

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (50 percent)

3.1.1 Theoretical Component

Students will be required to achieve all outcomes of the subject at this level. Assessment of all topics in this subject contributes to the formative assessment of the subject.

For Topic 1 (Fertilization of soils), 50 percent of the internal marks will be for the theoretical component. For Topics 2 and 3 (Soil water and evapotranspiration, and Soil erosion and its prevention), 60 percent of the internal marks will be for the theoretical component.

3.1.2 Practical Component

For Topic 1 (Fertilization of soils), 50 percent of the internal marks will be for the practical component. For Topics 2 and 3 (Soil water and evapotranspiration, and Soil erosion and its prevention), 40 percent of the internal marks will be for the practical component.

It must be clearly indicated which outcomes were achieved and the rating achieved for each. All practical components must be recorded in the Portfolio of Evidence (PoE).

Some of the practical work will be laboratory-type. Other practical work in the field may need to be dovetailed with Plant Production sessions.

- **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

The total internal mark for Topic 1 (Fertilization of soils), with the theory/practical weighting described above, will be converted to a mark out of 50. The total internal marks for Topic 2 (Soil water and evapotranspiration), with the theory/practical weighting described above, will be converted to a mark out of 20, and for topic 3 (Soil erosion and its prevention), with the theory/practical weighting described above, to a mark out of 30.

A year mark out of 100 is calculated by adding together the three total marks of the topics.

3.1.4 Moderation of internal assessment mark

Internal assessment is subject to both 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/s set externally and marked and moderated externally.

4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1. Fertilization of soils	50%
2. Soil water and evapotranspiration	20%
3. Soil erosion and its prevention	30%
TOTAL	100

5 CALCULATION OF FINAL MARK

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

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

7 SUBJECT AND LEARNING OUTCOMES

On completion of Soil Science Level 3 the learner should have covered the following topics:

Topic 1: Fertilization of soils
 Topic 2: Soil water and evapotranspiration
 Topic 3: Soil erosion and its prevention

7.1 Topic 1: Fertilization of soils

7.1.1 Subject Outcome 1: Identify essential elements in fertilizers and explain limiting factors

Learning outcomes

Students should be able to do the following:

- Explain the principle of "limiting factors".
- List the available sources of macro- and micro-nutrients.
- Describe deficiency symptoms in crop plants.
Range: Common examples in southern Africa.
- Explain the concept of mixed fertilizers and describe and use methods of applying solid fertilizers.
Range: Methods of application are hand placing or broadcasting.

7.1.2 Subject Outcome 2: Explain and demonstrate the use of organic fertilizers, and explain the advantages and disadvantages of organic and inorganic fertilizers.

Range: Organic fertilizers refer to animal manure, compost and green manure.

Learning outcomes

Students should be able to do the following:

- Explain the storage, treatment, management and application of animal manure and compost.
- Explain what plants are suitable for green manuring, their benefits and their problems.
- Explain the advantages and disadvantages of organic and inorganic fertilizers, including their impact on soil micro-organisms and soil acidity.

7.1.3 Subject Outcome 3: Explain what is meant by problem soils and explain the properties of each.

Range: Problem soils refer to acidic, alkaline and sodic soils.

Learning Outcomes

Students should be able to do the following:

- Explain the causes of acidic, alkaline and sodic soils.
- Explain and demonstrate methods of determining the pH of soil.
- Describe the treatment of acid, alkaline and sodic soils and their management.

7.1.4 Subject Outcome 4: From soil analysis results, calculate fertilizer requirements to influence harvest.

Learning Outcomes

Students should be able to do the following.

- Collect samples from the field following set procedures.
- Interpret soil sample results in order to calculate fertilizer requirements of a soil, as nutrient and fertilizer applications per hectare or square metre.

7.2 Topic 2: Soil, water and evapotranspiration

7.2.1 Subject Outcome 1: Explain the forms of soil water and evapotranspiration

Learning Outcomes

Students should be able to do the following:

- Explain soil water types, soil water movement, field capacity, and capillary movement.
- Explain evapotranspiration, and evaporation control by mulches.

Range: Potential evapotranspiration and corresponding calculations not required.

7.2.2 Subject Outcome 2: Calculate irrigation requirements

Learning Outcome

Students should be able to do the following:

- Given areas of land and the amount of precipitation for which irrigation must substitute, students should be able to calculate the amount of water needed in sprinkler irrigation.

7.3 Topic 3 Soil erosion and its prevention

7.3.1 Subject Outcome 1: Explain the causes of soil erosion, its main forms and consequences.

Learning Outcomes

Students should be able to explain the following.

- The basic factors affecting the amount of erosion (intensity and duration of rainfall, vegetation or equivalent cover, steepness and length of slope and erodibility of the particular soil).

Range: Quantitative treatment, and calculations using the universal soil loss equation, not required.

- Indicators of erosion, using examples.
- The impact of erosion on the soil profile depth, soil fertility and plant production.

7.3.2 Subject Outcome 2: Explain preventative measures for soil erosion.

Learning Outcomes

Students should be able to do the following:

- Explain different preventative and treatment measures.
Range: Include control of grazing, cover crops and mulching, contour ploughing, ridging and terracing and measures to combat gully erosion.

8 RESOURCE NEEDS FOR THE TEACHING OF PRIMARY AGRICULTURE

8.1 Phased development of training and demonstration farm

The following is a summarised phased development approach that is suggested for the establishment of a training and demonstration farm mainly for the NCV programme. It is suggested that the development of the programme be done in phases. Staff appointment has not been included

- **Phase 1:**
 - Farm layout or land use planning
 - Bush clearing on cropland
- **Phase 2:**
 - Build, equip and stock the broiler unit
 - Build, equip and stock the egg layer unit
 - Install irrigation reticulation
 - Establish vegetable field crops and seedling units
 - Establish a beekeeping unit
 - Erect external security fence
- **Phase 3**
 - Establish pastures
 - Erect internal fences and allocate grazing camps
- **Phase 4**
 - Build, equip and stock dairy, beef, goat and pig units
 - Extend training courses

8.2 Resource needs training and demonstration

FARM INFRASTRUCTURE	
1. BROILER PRODUCTION AND PROCESSING UNIT	<ul style="list-style-type: none"> • Building costs: 5 x 57.5m² • Equipment (brooders, drinkers, tube feeders) • Complete broiler processing equipment
2. LAYER AND EGG PROCESSING UNIT	<ul style="list-style-type: none"> • Building costs: 1 x 64m² • Equipment (includes cages) • 500 point of lay 20 week old pullets
3. DAIRY AND MILK PROCESSING UNIT	<ul style="list-style-type: none"> • Buildings • Equipment for milking and milk processing • 12 heifers
4. BEEF UNIT	<ul style="list-style-type: none"> • Sheltered beef feedlot unit: 1 x 30m • Beef handling pens and equipment • 12 Nguni heifers • 1 Nguni bull
5. GOAT UNIT	<ul style="list-style-type: none"> • 20 young nanny goats • 2 quality breeding billy goats • Goat handling pens and equipment
6. PIG UNIT	<ul style="list-style-type: none"> • Buildings

	<ul style="list-style-type: none"> • Equipment (brooders, farrowing rails, troughs) • 8 gilts and 2 boars
7. APIARY UNIT	<ul style="list-style-type: none"> • Apiary equipment including honey extractor
8. ESTABLISHED PASTURES	<ul style="list-style-type: none"> • Land preparation, fertilisation planting 8ha
9. IRRIGATION	<ul style="list-style-type: none"> • 1ha vegetables, 4ha maize/beans and 8ha pastures • Rising main from the river to reservoir and gravity flow (lower lands, paddocks) or booster pump (upper lands)
10. FARM TOOLS AND AGROCHEMICALS	<ul style="list-style-type: none"> • Equipment (hand tools, knapsacks, mower, wheelbarrows, spades etc.) • Farm shed
11. SEEDLING NURSERY (Vegetables, trees, shrubs)	<ul style="list-style-type: none"> • Shadecloth, poles, standpipes, equipment
12. WATER RETICULATION	<ul style="list-style-type: none"> • Reticulation to paddocks, livestock units
13. VEHICLES	<ul style="list-style-type: none"> • 1 tonne pick up and canopy • 1 medium size tractor • 1 mini bus for transporting learners • Tractor trailer and implements
14. FENCING	<ul style="list-style-type: none"> • External security fence: 2 km • Internal fences: 1.6km
15. MISCELLANEOUS	<ul style="list-style-type: none"> • Laboratory with equipment for plant and soil science • Laboratory with equipment for animal & poultry science • Teaching aids (data projectors, screen, DVD player etc.) • Computers with internet links • Library with relevant books and magazines