education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATES (VOCATIONAL)

SUBJECT GUIDELINES

SOIL SCIENCE

NQF LEVEL 2

September 2007

INTRODUCTION

A. What is Soil Science?

The National Certificates (Vocational) extends from NQF Levels 2 to 4 in Further Education and Training Colleges. Soil science, followed by Farm Planning and Mechanisation, is a Vocational subject in the Primary Agriculture programme of the National Certificates (Vocational). The subject covers the following fields of study:

- Some aspects of atoms and molecules (This will enable students to understand concepts not only in Soil Science but also in Animal Production and Plant Production.)
- Soils and their components
- Plants' requirements from soils to grow
- 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, Agribusiness.

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 and go beyond this immediate context 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; they will have more information available and be 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 NQF 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 lab and field methods, would suffice. Practical field work with soils is likely to be done in the same places as for Plant Production. For agricultural mechanisation at NQF Level 4, it may be necessary to negotiate access to other places 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.

SOIL SCIENCE – LEVEL 2

CONTENTS

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 student meets all the assessment requirements.

2 SUBJECT LEVEL FOCUS

The student will able to use Soil Science to show how soil influences the growth of plants.

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (50 percent)

3.1.1 Theoretical component

The theoretical component forms 60 percent of the internal assessment mark.

Internal assessment of the theoretical component in Soil Science Level 2 takes the form of observation, class questions, group work, informal group competitions with rewards, individual discussions with students, class, topic and semester tests and internal examinations. Lecturers can observe students when marking exercises from the previous day and asking class questions.

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

3.1.2 Practical component

The practical component forms 40 percent of the internal assessment mark.

Practical components include applications and exercises. All practical components must be indicated in a Portfolio of Evidence (PoE). Most of the practical assessments will be laboratory-style practical work but there should also be some practical experiential training, similar to workplace practice, particularly for soil sampling and testing.

3.1.3 Processing of internal assessment mark for the year

The internal assessment mark for Topic 1 (Basic Aspects of Atoms and Molecules) will be converted to a mark out of 50. The internal assessment marks for Topics 2 and 3 (Soils and Their Components and What Plants Require from Soils for Growth) will each be converted to a mark out of 25.

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

3.1.4 Moderation of internal assessment mark

Internal assessment is subjected to 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. A practical component will also be assessed.

External assessment details and procedures are set out in the *Assessment Guidelines: Soil Science* (Level 2).

4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1. Basic Aspects of Atoms and Molecules	50%
2. Soils and Their Components	25%
3. What Plants Require from Soils to Grow	25%
TOTAL	**100%**

5 CALCULATION OF FINAL MARK

Internal assessment mark:	Student's mark/100 x 50 = a mark out of 50 (a)
Examination mark:	Student's mark/100 x 50 = 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, reporting, moderation and verification purposes.

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 Soil Science Level 2, the student should have covered the following topics:

Topic 1: Basic Aspects of Atoms and Molecules
Topic 2: Soils and Their Components
Topic 3: What Plants Require from Soils to Grow

7.1 Topic 1: Basic Aspects of Atoms and Molecules

Subject Outcome 1: Explain basic concepts of atoms and molecules and show an understanding of some basic properties of selected elements and radicals.

Learning Outcomes:

The students should be able to:

- Explain that matter consists of atoms which are made up of protons, neutrons and electrons. These atoms combine to form molecules.

  RANGE: Electronic configuration and periodic table NOT required
- Explain the difference between elements, compounds and mixtures.
- Explain that sometimes atoms gain or lose electrons to become charged ions.
- Give examples of elements, simple compounds and mixtures, explaining what elements are in the compounds.
- Conduct some simple chemical experiments.

  RANGE:

  Elements to include: C, H, O, N, P, S, K, Na, Ca, Mg, Fe

  Radicals to include: OH, NO_3, PO_4, SO_4, CO_3, HCO_3

  Compounds to include CO_2, H_2O, NaCl

No concentrated acids or other very hazardous chemicals are to be handled by students.

Subject Outcome 2: Explain changes of state in molecular terms.

Learning Outcome:

The students should be able to:

- Give every-day examples of changes of state, particularly evaporation and condensation, explaining the changes in terms of molecules.

  RANGE: No calculations, for example, using specific heat

Subject Outcome 3: Explain the concept of relative humidity in molecular terms.

Learning Outcomes:

The students should be able to:

- Measure dew point and relative humidity and explain observations in molecular terms.
- Explain how relative humidity affects rates of evaporation and transpiration because of diffusion and "back diffusion".

RANGE: No calculations required

7.2 Topic 2: Soils and Their Components

Subject Outcome 1: Explain the concept soil.

Learning Outcome:

The students should be able to:

- Explain that soil consists of a mixture of several basic components which affect soil properties in various ways.

RANGE: Air, water, mineral particles (different sizes) and humus

Subject Outcome 2: Explain how soils are formed and describe the properties of the main layers.

Learning Outcome:

The students should be able to:

- Outline, in very simple terms, the weathering of rock and the effects of living organisms on developments.

RANGE:

No details of rock minerals or the chemical reactions involved

Main layers of soil: Topsoil, subsoil and parent material

Cover basics of eluviation and illuviation in terms of movement of clay particles and leaching and upward transport of mineral nutrients by plants

Subject Outcome 3: Identify and describe the main soil types and texture classes using examples.

Learning Outcomes:

The students should be able to:

- Explain the difference between sand, silt and clay particles.
- Explain the effect of different proportions on soil properties.
- Show the use of the soil texture triangle diagram.
- Briefly explain crumb structure as a result of humus content.

Subject Outcome 4: Explain soil sampling methods and some simple soil tests.

Learning Outcomes:

The students should be able to:

- Explain how to ensure that samples give a fair representation of a plot.
- Take samples from a plot and use some simple tests.

RANGE: No statistical calculations

Simple tests include soil texture ("roll the soil into a ball or sausage" etc.) and pH

7.3 Topic 3: What Plants Require from Soils to Grow

Subject Outcome 1: Identify and describe, with examples, the effects of different elements that influence growth in plants.

Learning Outcome:

The students should be able to:

- List major nutrient elements and explain in simple terms why plants need them.

RANGE: No biochemical details required

N, P, K, Ca, Mg and formation of amino acids and proteins

Subject Outcome 2: Explain how plants take up water and mineral nutrients from soils.

Learning Outcome:

The students should be able to:

- Explain that fine roots usually grow to get to water and nutrient ions (hence importance of aeration).
- Explain ion exchange in very simple terms.

RANGE:

Very simple treatment of osmosis

No details of ion uptake mechanisms or how cell membranes work