

NATIONAL UNIVERSITY OF LESOTHO
FACULTY OF AGRICULTURE
DEPARTMENT OF SOIL SCIENCE & RESOURCE CONSERVATION

SSR220/4 – FUNDAMENTALS OF SOIL SCIENCE

FINAL EXAMINATION

Programmes:

**B.Sc. Agriculture – General, and Soil Science, Crop Science, Agricultural Extension
and Agricultural Economics options;**

B.Ed and B.Sc.Geography, and B.Sc. Environmental Sciences

Year 2

May 2016

Total marks = 100

Time: 3 Hours

INSTRUCTIONS: Answer ALL Questions

Question1 (30 marks)

(a) Answer true or false:

[1 mark each]

- (i) Soil formation processes involve physical breakdown (weathering) of the parent rock into loose materials and continuous chemical weathering into soil mineral particles. Movement and deposition of weathered rock materials at some other different locations either by water or wind; are normally not the processes of soil formation.

TRUE/FALSE?

- (ii) In soil formation processes namely, weathering of the parent materials and the mixing of unconsolidated materials as well as transformations, translocations, additions and losses of some minerals and organic compounds are all facilitated by actions of organisms and water. , resulting in the development of layers of different characteristics addition to,.

TRUE/FALSE?

- (iii) Soil formation processes and soil formation factors are one and the same thing, and they determine the type of the product soil.

TRUE/FALSE?

- (iv) Horizonation is the development of layers of different characteristics through a sequence of processes of transformations, translocations, additions and losses of some minerals and organic compounds; and mixing of unconsolidated materials by action of organisms and water, hence is the soil formation process.

TRUE/FALSE?

- (v) In soil formation, continuous physical weathering and chemical decomposition comprise minor chemical alterations of some original parent rock minerals and/or complete dissolution of the other, as well as the synthesis of new minerals. The latter are soil minerals namely, (1) silicate primary minerals, (2) silicate clays, (3) and some very resistant non-silicate clay minerals like oxides of iron and aluminum.

TRUE/FALSE?

- (vi) The sand and silt particles of soil consist of silicate primary minerals, all of which serve as basis for the synthesis of secondary minerals; they contain no minerals that are resistant to further weathering.

TRUE/FALSE?

(b) Give the criteria for description of soil parent materials.

[4 marks]

(c) Name the following soil parent materials:

[2 marks each]

- (i) Residual material weathered from the underlying rock:
- (ii) Materials deposited by wind:
- (iii) Aeolian materials consisting of very fine particles (1–10µm) that can remain suspended in air, usually deposited with rain:
- (iv) Aeolian materials of very fine glassy ash particles blown down from the volcano during volcanic eruptions:
- (v) Rock fragments detached from the heights above, and carried down–slope normally by gravitational force (sometimes plus frost action):
- (vi) Sediments deposited by ice or associated water:
- (vii) Sediments deposited in lakes by water melting from the glaciers (glacial lakes), including delta material and beach deposits, valley fills and outwash plains:
- (viii) Weathered rock materials deposited into the lake/sea/ocean by the stream, normally near the mouth of the stream, forming a delta:
- (ix) Weathered materials that end up in the sea/estuaries/gulfs and later raised above the sea as the elevation of the latter (sea/...) and the land changes into coastal plains:
- (x) Organic materials of varying origin, accumulating in wet places where decomposition rate is reduced, then sink in water:

Question 2 (20 marks)

- (a) What is soil texture? [2 marks]
- (b) Estimate the textural class of a soil consisting of 30%clay and 40% silt? [2 marks]
- (c) Calculate %sand fraction of the soil in (b) above. [2 marks]
- (d) Give the types of soil separates larger than the primary soil particles, and their respective sizes. [4 marks]
- (e) What is the normal limit of those separates that determines whether or not they influence the textural class name of a particular soil? [2 marks]
- (f) How would the soil textural class name for soil described in (b) and (c) above be affected by presence of one of those large fragments? [3 marks]
- (g) With examples, describe the influence of organic matter content on soil textural class names. [5 marks]

Question 3 (20 marks)

- (a) What is soil structure? [2 marks]
- (b) Give two major broad groups of agents of soil structural development and the role that each group plays. [2 marks]
- (c) Give the agents of soil structural (aggregate) stability and explain the effect of each on aggregate stability. [4 marks]
- (d) What is soil consistency? [3 marks]
- (e) Give the terms used to describe soil consistency at dry, moist and wet soil moisture levels, and show which soil textures normally exhibits the respective consistency classes. [9 marks]

Question 4 (30 marks)

- (a) Give two examples for each of the primary and secondary soil minerals. **[4 marks]**
- (b) What are the roles of the primary and secondary soil minerals in soil chemical characteristics? **[3 marks]**
- (c) What is cation exchange capacity (CEC)? **[3 marks]**
- (d) Give the two types of charge that constitute CEC. **[2 marks]**
- (e) Describe the development of each type of charge requested for in (d) above. **[4 marks]**
- (f) What is soil pH? **[4 marks]**
- (g) Give the normal range of soil pH. **[2 marks]**
- (h) Give an average soil pH range that is most favorable for plant growth, nutrients availability and microbial activities. **[2 marks]**
- (i) Give the soil factors that determine CEC in soil. **[4 marks]**
- (j) What is the other chemical soil property besides those mentioned in (a) to (i) above? **[2 marks]**