



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND
TECHNOLOGY SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES
UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF
SCIENCE IN SOIL SCIENCE
2ND YEAR 1ST SEMESTER 2016/2017 ACADEMIC YEAR
MAIN CAMPUS**

COURSE CODE: ALS 3214

COURSE TITLE: SOIL CHEMISTRY

EXAM VENUE: LAB 9 STREAM: (BSc.)

DATE: 26/04/16 EXAM SESSION: 2.00 – 4.00 PM

TIME: 2 HOURS

Instructions:

- 1. Answer question 1 (compulsory) and ANY other 2 questions.**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

Question 1

a) Soil acidification is a major concern in plant growth. Outline the major soil acidification processes under the following subtopics

- i. Acidification from water. (1 mark)
- ii. Acidification from CO₂. (1 mark)
- iii. Acidification from Organic acids. (1 mark)
- iv. Acidification from oxidation of S and N. (1 mark)

b) Soil acidification can also arise out of other factors such as from Chemical fertilizers, acid rains and mining wastes. Give the chemical processes that take place when:

- i. A farmer uses ammonium based fertilizers. (2 marks)
- ii. Ferrous materials are added to soils. (2 marks)
- iii. Elemental sulfur is added to soils. (2 marks)
- iv. The acid rain after N and S has been released to the environment . (2 marks)
- v. Mining wastes that contain S²⁻ species. (2 marks)

c) Define the following terms as used in soil science. (6 marks)

- i. Soil
- ii. Soil chemistry
- iii. Inorganic soil fraction
- iv. Soil Colloids
- v. Edaphology
- vi. Pedology

d) What are the four soil constituents. (2 marks)

e) The soil liquid phase (soil moisture) is a very essential soil component in soil chemistry. List its function in soil chemistry and some of its components. (2 marks)

f) Briefly explain the functions of the following in the soil. (4 marks)

- i. Dissolved oxygen
- ii. Dissolved CO₂
- iii. Biological oxygen demand
- iv. Soil air

g) Soil silicates can be classified according to the arrangements of the SiO₄ tetrahedral in their structure. Give the observed morphology of the following classifications. (6 marks)

- i. Cyclosilicates

- ii. Inosilicates
- iii. Nesosilicates separate
- iv. Phyllosilicates
- v. Sorosilicates
- vi. Tectosilicates

Section B. Answer any TWO questions

Question 2.

- g) In soil science, cation-exchange capacity (CEC) is the number of exchangeable cations per dry weight that a soil is capable of holding, at a given pH value, and available for exchange with the soil water solution. CEC is used as a measure of soil fertility, nutrient retention capacity, and the capacity to protect groundwater from cation contamination. It is expressed as milli-equivalent of hydrogen per 100 g of dry soil (meq⁺/100g), or the SI unit centi-mol per kg (cmol⁺/kg). Briefly discuss the CEC process and explain the fate of CEC to plants grown in soils rich in the following environments (4 marks for description).
- i. Rich in Aluminium ions. (4 marks)
 - ii. Low pH. (4 marks)
 - iii. High organic matter. (4 marks)
 - iv. High sodium levels. (4 marks)

Question 3

- a) The structural chemistry of clay materials can be used to characterize different soil types. Soil clays can exist in crystalline, structurally disordered, or amorphous form. These soil clay features can be identified using techniques of x-ray diffraction analysis. Give a brief explanation of how the x-ray diffraction analysis works and sketch a possible spectra resulting from an x-ray diffractometer machine. (8 marks)
- b) A part from x-ray diffraction analysis, clay soils can also be categorized using differential thermal analysis (DTA). Briefly explain how these technique works. (4 marks)
- c) The surface chemistry of soil clays can also be divided into at least 3 categories. Briefly describe these categories. (8 marks)

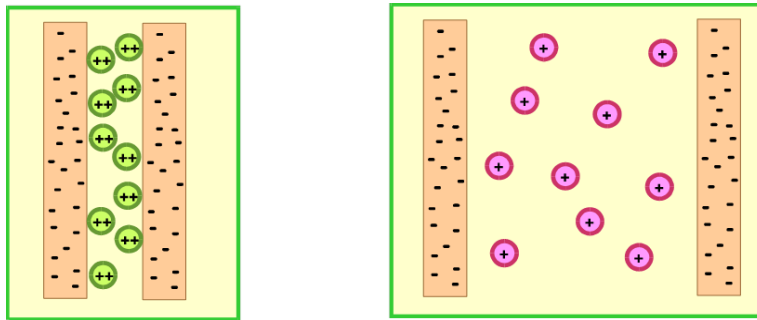
Question 4

- a) Name at least two common minerals of the following phyllosilicate minerals in soils. (6 marks)
- i. Kaolinite
 - ii. Pyrophyllite
 - iii. Chlorite

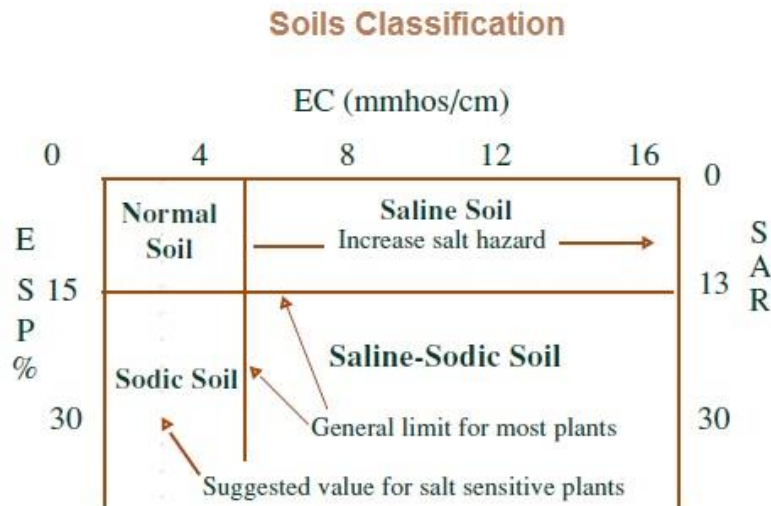
- b) In case of a soil analysis by X-ray diffraction and the spectra shows featureless curves, Explain diagrammatically two other methods that can be employed to classify the soil. (4 marks)
- c) Many, if not all, of the chemical reactions of soil clays are surface phenomena (e.g. cations exchange, and adsorption of water). Clay surfaces can be divided into at least 3 categories. Briefly describe these classifications. (10 marks)

Question 5

- a) Discuss the sodium ion effect on soils with the help of the following diagram. (10 marks)



- b) Discuss the relationship between salinity and sodicity with the help of the following diagram. (4 marks)



- c) Describe the influence of pH on Sodic Soils. (3 marks)
- d) How can sodic soils be managed. (3 marks)

