"Investing in Africa's future"

COLLEGE OF HEALTH, AGRICULTURE & NATURAL SCIENCES

NACP 111: INTRODUCTION TO SOIL SCIENCE

END OF SECOND SEMESTER FINAL EXAMINATIONS

APRIL 2023

LECTURER: MRS. S. MBIZI

DURATION: 3 HOURS

INSTRUCTIONS

1. Read and understand all questions before you answer.
2. **Do not** write your name on the answer sheets.
3. All working for numerical answers must be shown.
4. The intended number of marks is given in brackets at the end of each question or part of the question.
5. Begin your answer for each question on a new page.

SECTION A (60 MARKS)

ANSWER **ALL** QUESTION FROM THIS SECTION

1. Describe the formation of various soils along a catena. (6)
2. Describe any TWO roles played by each of the following organisms in the soil.
   (i)   Bacteria (2)
   (ii) Earthworms (2)
3. (a) Define the term Bulk Density (2)
   (b) Describe the factors which affect the bulk density of a soil. (8)

4. List the causes of soil alkalinity. (3)
5. (a) Explain how isomorphous substitution leads to a permanent charge on a clay particle. (4)

   (b) Describe the structural differences between the 1:1 and 2:1 aluminosilicate clays. (6)

6. State the problems that can be experienced in soils with a high exchangeable sodium percentage. (4)

7. Write short notes on the following.
   (a) Podzolisation (3)
   (b) Saprolite (3)
   (c) Eluviation (2)
   (d) Illuviation (2)
   (e) Salinization (2)

8. Explain the importance of soil colour to a Soil Scientist. (3)

9. (a) What are the characteristics of the E horizon of the Soil Profile? (3)

   (b) State the Jenny's 5 factors of soil formation. (3)

10. Define Stoke's Law (2)

SECTION B

Answer any TWO questions in this section.

11. (i) With aid of illustrations, define the following terms:
    (a) Isomorphous substitution (I.S)
    (b) Cation Exchange Capacity (C.E.C)
    (c) Soil pH
    (d) Available Water Capacity (A.W.C)
    (e) Percentage Base Saturation(%.B.S)   (10)

    (ii)Discuss the effect of pH on Nutrient availability.   (10)

12. (a) Describe how Nitrogen is lost from soil cropping systems.   (10)
    (b) A soil has two horizons A and B. the following soil data were obtained for the profile.

Soil Horizon	A	B
Horizon Depth	0.0-150	150-400
Wilting Point (mm mm^{-1})	0.18	0.25
Field Capacity(mm mm^{-1})	0.34	0.40

    (i)   Define the term Available Water Capacity (AWC).   (2)
    (ii)   Calculate the AWC of each horizon in mm per 100mm   (2)
    (iii) Calculate the Plant available Water (PAW) of each horizon)   (3)
    (iv)   If a farmer is growing irrigated soya beans on this soil and the rooting depth is
           90cm, calculate the quantity of water a farmer must apply using a 60% depletion
           of the plant available water.   (3)

13. You have completed soil analyses on three different soils that a farmer has brought into
    your laboratory. The three soils A, B and C have the following exchangeable cations in
    their top soils (0-15cm depth), expressed in mmoles$_c$kg^{-1}.

ANALYSIS	SOIL A	SOIL B	SOIL C
Exchangeable Ca	45	10	20
Exchangeable mg	58	4	15
Exchangeable k	3	2	1
Exchangeable Na	2	0	6
Exchangeable H	1	5	1
C.E.C	112	27	45
pH	7.2	5.4	7.8

(a) Draw up a table for these three soils showing their
   (i)   Total Exchangeable Bases (TEB)
(ii)   Percentage Base Saturation(% BS)
(iii)   Percentage Hydrogen Saturations(% HS)
(iv)   ESP values
(v)   Ca/Mg ratios
(vi)   Exchangeable Ca in $cmoles_ckg^{-1}$ (10)

(b) Which of the soils is likely to be a clay soil? Justify your answer.   (2)
(c) Explain with the aid of diagram, the building blocks which are important in clay formation   (8)

<div align="center">END OF EXAMINATION PAPER</div>