



**SIR ARTHUR LEWIS COMMUNITY COLLEGE
ACADEMIC YEAR (2024/2025) – SEMESTER TWO
END OF SEMESTER FINAL EXAMINATION**

COURSE CODE : AGR102
COURSE TITLE : Fundamentals of Soil Science
LECTURER(S) : Julius Polius
DATE : Wednesday 7th May, 2025
TIME : 1:00 p.m. – 3: 00 p.m.
DURATION : 2 Hours
ROOM : VAR-0R-01
STUDENT ID # : _____

GENERAL INFORMATION AND INSTRUCTIONS

This examination consists of **TWO (2)** sections.

- **SECTION A** consists of **TWENTY-FIVE (25)** multiple choice questions. Answer **ALL** questions.
- **SECTION B** consists of **ONE (1)** essay-type questions and **FIVE (5)** structured questions. Answer **ANY THREE (3)** questions.
- Students must sign **IN** and **OUT** on the examination class list.
- Write your **Student ID** number on the question paper and question paper that is submitted.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO

SECTION A

INSTRUCTIONS: Answer **ALL** questions by shading the circle next to the correct response.

1. Chemical weathering processes involves:
 - a) Spheroidal weathering, hydration, CEC, pH
 - b) Flooding, precipitation, substitution, leaching
 - c) Solution, hydrolysis, oxidation, carbonation
 - d) Bonding, exchange, cations, ionization
2. The inter-relationship between parent materials is illustrated in the:
 - a) Earth's crust
 - b) Pedogenesis process
 - c) Rock cycle
 - d) Textural Triangle
3. Soil colour is measured using
 - a) Reflection, spectra, brightness
 - b) Munsell Color Notation
 - c) Paint charts
 - d) Colour meter
4. How many layers can be present in a typical soil profile:
 - a) 3
 - b) 4
 - c) 5
 - d) 6
5. Given a textural composition of 33% sand, 34% silt and 33% clay where on the textural triangle would this soil lie?
 - a) Silty Clay loam
 - b) Loam
 - c) Silt
 - d) Silty clay
6. The principle behind Stokes Law is that;
 - a) The larger particles settle more quickly
 - b) The velocity of settling (V) is proportional to the square of particle diameter
 - c) Clay particles move faster than sand particles
 - d) Both a and b above
7. Gravimetric, conductance, tensiometer, and volumetric are some of the techniques used to measure
 - a) Soil bulk density
 - b) Soil colour
 - c) Soil water infiltration rate
 - d) Soil moisture
8. Which of the following group of terms refer to soil structure sub-types
 - a) Glassy, clusters, separates, pedons
 - b) Macropores, micropores, void space, tubular
 - c) Granular, prismatic, blocky, platy
 - d) Profiles, layers, pans, matric
9. Salinization is:
 - a) Salt build-up in irrigation water
 - b) Evaporation of sea water
 - c) Salts occurring in the soil
 - d) Soil infertility

10. In terms of nutrient supplying capacity, how would you describe manure in comparison to synthetic fertilizers?
- Same as
 - Stronger
 - Depends on the source of manure
 - Low
11. What are the two main types of weathering processes that affect rocks?
- Chemical and Biological
 - Chemical and Physical
 - Physical and Agricultural
 - Mechanical and Sedimentary
12. The transportation and accumulation of dissolved or suspended materials within the soil is described as:
- Settling and mass flow
 - Adsorption and Precipitation
 - Diffusion and root interception
 - Eluviation and Illuviation
13. As clay minerals begin to precipitate out of solution, the cations of similar ionic radius may replace Silicon, Aluminum or Magnesium as the center of a given polyhedron. This is called _____.
- Precipitation
 - Isomorphous Substitution
 - Replacement
 - Both B and C
14. Soil Taxonomy:
- A system of soil classification
 - An arrangement of soil orders
 - A listing of the products of soil formation
 - Textural classification of soils
15. The process of $\text{NH}_4^+ \rightarrow \text{NO}_2^- \rightarrow \text{NO}_3^-$ involves the following organisms
- Azotobacter and Clostridium
 - Earth worms and fungi
 - Rhizobium and Thiobacillus
 - Nitrobacter and Nitrosomonas
16. 16-8-24 +2MgO 0.1B is a grade/analysis of fertilizer commonly used in the banana industry. This represents, respectively, the amounts of the following nutrients
- Nitrogen, Phosphorus, Potassium, Magnesium and Boron
 - Nitrogen, Phosphorus, Potassium, Manganese and Boron
 - Urea, Triple superphosphate, Muriate of Potash, Sulpomag, Borax
 - Major, Minor, Trace and Micro
17. Laterization, Podzolization, Calcification, Salinization and Glaciation are:
- Physical and Chemical processes
 - Principal pedogenic processes acting on soils
 - Systems of soil classification
 - Types of soil
18. Which of the following groups of essential plant nutrients are classified as 'micro'?
- Carbon, Hydrogen and Oxygen
 - Copper, Zinc and Manganese
 - Nitrogen, Potassium and Phosphorus
 - Iron, Aluminum and Cobalt

19. Which of the following are examples of igneous rocks?
- Silicates, ferro-magnesium, peat and schist
 - Gabbro, dacite, andesite and basalt
 - Mica, amphiboles, lava, magma
 - Quartz, feldspars, biotite and pyroxenes
20. Organic matter has a strong impact on the following soil properties
- Parent material, soil profile, and soil horizon
 - Soil structure, Available Water Capacity and Cation Exchange Capacity.
 - Mineralization, immobilization and precipitation
 - Humic acid, acidification, lime requirement
21. Which soil parameter that you measure is affected by the amount of pore space, type of minerals present, texture, and amount of organic matter?
- Water holding capacity
 - Compaction
 - Soil fertility
 - Bulk density
22. The biological component of soil comprises of:
- Flora and fauna
 - Live and dead (organic matter)
 - Macroscopic and microscopic organisms
 - All of the above
23. The following are the results of a chemical analysis of a sample taken from Balembouche Gritty clay loam soil: Calculate the CEC of the soil.

Meq/100g					ppm		
H ⁺	Ca ²⁺	Mg ²⁺	K ⁺	Na ⁺	N	P	S
2	9.7	7.12	0.05	1	4	1	26

- 19.87
 - 50.87
 - 17.87
 - 31
24. Using the data in question 23, calculate the Percent Base Saturation of the soil
- 89.93
 - 35.13
 - 39.06
 - 100
25. A soil with a pH of 6.5 has which of the following conditions?
- Weakly alkaline, no lime needed, fixes phosphorous, favors bacterial activity.
 - Moderately acid, lime needed, phosphorus soluble, favors fungal activity.
 - Slightly acid, lime generally not required, phosphorus soluble, favors bacterial activity
 - Alkaline, no lime needed, phosphate fixed, favors fungal activity

SECTION B

INSTRUCTIONS: Please answer **ANY THREE (3)** questions.

QUESTION ONE

- a) Describe how soil holds nutrients and releases them for plant uptake.

(25 marks)

Total 25 marks

QUESTION TWO

Plants require adequate amounts of 17 essential nutrients for optimum growth. Answer the following:

- i. List the possible sources of these nutrients.

(5 marks)

- ii. List the main types of fertilizer used to supply nutrients.

(2 marks)

- iii. For each of the following elements: Nitrogen, Phosphorus, and Potassium. List **TWO (2)** fertilizer products used in crop production.

(6 marks)

- iv. List **SIX (6)** fertilizer application methods commonly used in commercial farming operations.

(6 marks)

- v. A 50 kg bag of an NPK fertilizer blend is labeled with a guaranteed analysis of 16-8-24 + 2MgO + 0.1B.

Calculate the amount (in kg) of elemental N, P, K, Mg, B, and filler present in the bag.

(6 marks)

(Use the following conversion factors: P_2O_5 to P = 0.44; K_2O to K = 0.83; MgO to Mg = 0.60)

Total 25 marks

QUESTION THREE

A study was carried out on a research plot at Union Agricultural Station with the following dimensions (meters): Length: 30; Width: 10; Effective soil depth: 0.1

I. Part I – Metal Core Sampling

A metal core was used to assess some of the physical properties of the soil at the 6 – cm depth and the following information applies:

- Weight of empty core: 102g
- Weight of core + Wet soil: 260g
- Weight of core + Dry soil: 220g
- Length of core: 5 cm
- Diameter of core: 5 cm

II. Part II – Wilting Point Determination

During a severe drought, when plants in the plot reached the permanent wilting point, **TWENTY (20)** soil samples were randomly collected to a depth of 6 cm across the area. These were combined to form a well-mixed composite sample, from which a sub-sample was analyzed to determine soil moisture content.

- Weight of empty can: 50g
- Weight of can + wet soil: 273g

c) Weight of can + dry soil: 259.4g

III. Part III – Moisture Content After Rainfall

Two days after a long, steady rainfall, the **gravimetric moisture content** of the soil was determined using the following data - Once, 2 days after a long period of steady rainfall, the gravimetric moisture content of the soil was measured and calculated using the following data:

- a) Weight of empty can: 100g
- d) Weight of can + wet soil: 350g
- e) Weight of can + dry soil: 291.57g

Using the data above, calculate the following (show all workings):

- a) Bulk density of the soil **(4 marks)**
- b) Porosity **(3 marks)**
- c) Gravimetric water content (%) **(3 marks)**
- d) Volumetric water content (%) **(3 marks)**
- e) Moisture saturation in the core (%) **(3 marks)**
- f) Permanent wilting point (%) **(3 marks)**
- g) Field capacity (%) **(3 marks)**
- h) Maximum available water (%) **(3 marks)**

Total 25 marks

QUESTION FOUR

Soil acidity and the conditions that lead to acid soil development are important considerations in managing soils for crop production. With that in mind, answer the following:

- a) What is meant by an acid soil? **(2 marks)**
- b) List **THREE (3)** activities that tend to increase soil acidity. **(3 marks)**
- c) Do plants get sufficient calcium in soils of low pH? Explain your answer. **(5 marks)**
- d) Does soil acidity influence the activity of microorganisms? Explain your answer. **(5 marks)**
- e) How does the application of **lime** to an acid soil influence:
 - i. Soil productivity
 - ii. The efficiency of applied fertilizers and manure**(10 marks)**

Total 25 marks

QUESTION FIVE

Select **ANY FIVE (5)** of the terms listed below. For **EACH** selected term, provide a definition and explain its relevance to soil science.

- a) Essential Plant Nutrients (5 marks)
- b) Isomorphous substitution (5 marks)
- c) Soil Taxonomy (5 marks)
- d) Textural Triangle (5 marks)
- e) The Rock Cycle (5 marks)
- f) Factors of soil formation (5 marks)
- g) Soil Organic Matter (5 marks)

Total 25 marks

END OF EXAM