

Faculty of Agriculture, University of Ruhuna
Second Examination in
BSc Agricultural Resource Management and Technology/BSc Agribusiness Management (Part I)
June 2016
SS 2101 – Soil Plant Relations & Nutrient Management (Theory)

Time: Three (3) hours

Index No:.....

INSTRUCTIONS

- Paper consists of 6 questions.
- Answer **5 questions** including the question **one** (First question is **compulsory**).
- Answers to the question **1 should be written** in the given spaces.
- Only non-programmable calculators are permitted.
- Mobile phones are **NOT** permitted.

1. I. a) Define field capacity of a soil. (5 marks)

b) Name five structure related properties of water. (10 marks)

c) Name the functions used in the equation used to find the capillary rise. (10 marks)

d) State the major processes involved in the soil nitrogen cycle. (10 marks)

e) What is the importance of phosphate solubilizing microorganisms on phosphorus availability? (5 marks)

f) Name two minerals which release potassium into soil solution. (5 marks)

g) What are the usable ionic forms of nitrogen, phosphorous and potassium? (5 marks)

II. a) List five major components of soil organic matter. (2.5 marks)

b) Order the above mentioned components according to their resistance to the decomposition. (2.5 marks)

c) What are the pathways that lead to the reduction in organic matter level in a soil system? (5 marks)

d) Complete the blanks in the equation related to plant residue decomposition.



e) What is the average C:N ratio of microbial biomass? (2.5 marks)

f) How many units of C is needed for the microorganisms to survive and maintain the above mentioned C:N ratio? (2.5 marks)

g) After adding organic matter to a soil, a deficit of nitrogen in the soil solution aroused at a rate of 2 kg/ Ha. How many kilograms of urea (CH_4N_2O) should be added to cover the deficit? (5 marks)

III. a) Name two renewable nutrient resources. (2 marks)

b) State the qualitative and quantitative methods of soil fertility evaluation? (6 marks)

c) Of these methods list two disadvantages of the qualitative method. (4 marks)

d) Name five (5) visual symptoms of plant nutrient deficiencies. (5 marks)

e) Write three examples of mobile nutrients. (3 marks)

f) Determine ratios for the following fertilizer grade. (3 marks)

N- 46% P₂O₅- 24% -K₂O 4%

g) Write two major digestion methods of composting? (2 marks)

2. I. a) Name the major components in soil. (5 marks)

b) Explain what is meant by mass (gravimetric) water content of soil using a defined equation. (5 marks)

c) Explain what is meant by volumetric water content of soil using a defined equation. (5 marks)

d) Briefly explain the procedure of determining gravimetric water content of soil in the laboratory. Include all the steps. (15 marks)

II. a) Name the main components in soil water. (5 marks)

b) State the availability of the components you have mentioned in II. a) under following conditions. (10 marks)

i. Just after very heavy rainfall:

ii. Soil in field capacity:

iii. Thoroughly air-dried soils:

iv. Oven-dried soils (assume no water attracted after oven drying):

c) Among the four situations described above (b), name which situation/s would allow uptake of water by plants? (10 marks)

III. a) What is meant by capillarity? (10 marks).

b) Comparatively describe the changes in water content and water potential in soil considering wetting (Ex: with rainfall) and drying (dry season). (15 marks)

c) A first year student stated in a lab report that "Capillary rise in soil is identical to the capillary rise in glass tubes." Do you agree with his statement? Justify your answer. (20 marks)

3. I. a) Name three things that happen during the plant residue decomposition (6 marks)

b) If two natural ecosystems, each from Nuwara Eliya and Matara area are compared, which ecosystem may have a comparatively higher decomposition rate? (4 marks)

c) State the reason for your answer to the above question. (20 marks)

II. a) When the two processes, immobilization and mineralization of nutrients are concerned which favors the plant nutrient absorption? (5 marks)

b) State the reason for the above answer. (10 marks)

c) Explain briefly the importance of immobilization of nutrients on plant nutrition. (10 marks)

- III. a) What is C:N ratio of organic matter? (5 marks)
 b) Among *Gliricidia* leaf litter, poultry manure, saw dust and paddy straw, which may have low C:N ratios? (10 marks)
 c) State the reason/s for your answer to the above question. (10 marks)
 d) Show how the chemical properties of a soil are improved by the addition of organic matter and cost of fertilizer can be cut down. (20 marks)
4. I. a) Differentiate phosphorous fixation and nitrogen fixation. (10 marks)
 b) Trace the pathway by which nitrogen is released from dead organic matter and converted to the form in which it is assimilated by plants. Name organisms involved in this process. (15 marks)
 c) Why is it important to regulate the O₂ concentration in a root nodule? How is this regulation achieved? (10 marks)
 d) The relationship between root nodule and rhizobium is mutual. Why? (10 marks)
- II. a) What are the problems associated with soil phosphorous? (5 marks)
 b) Using an appropriate diagram, illustrate the effect of pH on the relative concentrations of the three species of phosphate ions. (15 marks)
 c) Describe briefly the factors which can control the availability of inorganic phosphorous in soil. (15 marks)
- III. a) What are the major forms of potassium in soil? (10 marks)
 b) What is meant by 'luxury consumption' of potassium? (10 marks)
5. I. a) Differentiate the difference between mobile and immobile nutrients. (10 marks)
 b) Name the element which has the intermediate mobility and explain the deficiency symptoms in plants. (10 marks)
 c) Explain briefly the phosphorus deficiency symptoms in plants. (10 marks)
 d) Write five steps on preparation of soil samples before soil analysis. (10 marks)
- II. a) What is a fertilizer? (10 marks)
 b) Define the fertilizer grade. (10 marks)
 c) Explain the 'law of the minimum' regarding the nutrient requirement of plants. (15 marks)
- III. a) Write the four (4) major steps in anaerobic digestion of organic matter. (5 marks)
 b) Tabulate the advantages and disadvantages of organic fertilizers. (20 marks)
6. Write short notes on;
- a) Inorganic fixation of added phosphorous at various soil pH values. (25 marks)
 b) "Soil texture is one of the most important fundamental properties affecting how water moves through soil." Explain the statement considering the water movements through sandy and clayey soils. (25 marks)
 c) "Application of inorganic fertilizer more than the recommended level causes severe environmental problems". Explain the statement using the example situations in Sri Lanka. (25 marks)
 d) Soil fertility vs soil productivity. (25 marks)