

**FACULTY OF AGRICULTURE - UNIVERSITY OF RUHUNA**  
**FIRST EXAMINATION IN B. Sc. ARMT/AB/GT (PART/II) – FEBRUARY 2019**

SS1201 Introductory Soil Science (Theory)

Time: 03 Hours

**INSTRUCTIONS**

- Answer five (05) questions including the question number 1.
  - Write your answers **ONLY** in the space given for the question number 1.
  - Each question carries a total mark of 100.
  - Only non-programmable calculators are permitted.
  - Mobile phones are **NOT** permitted.
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1. (a) i. Indicate the most reliable physical property which can be used to identify the following pairs of minerals. (8 Marks)

Hematite and Galena:.....

Halite and Calcite:.....

Talc and Topaz:.....

Quartz and Rose Quartz:.....

ii. Name the types of weathering. (6 marks)

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iii. What are the major groups of soil parent materials? (6 Marks)

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(b) i. Name the three (03) color dimensions used in the determination of soil color (5 marks)

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ii. The color notation of a soil is recorded as 10YR 6/4. Identify each color dimension you mentioned above in this color notation. (5 marks)

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iii. Name four (04) factors that affect soil color. (5 marks)

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iv. State the typical reason for surface layer in a soil profile to be dark in color. (5 marks)

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(c) Mark each of the following statements true or false (20 marks).

Statement	True/False
Isomorphous substitution involves the substitution of a tetrahedral sheet for an octahedral sheet.	
Sandy soils typically have a lower CEC and require more frequent fertilizer applications.	
Vermiculite and associated silicate clays have a net positive charge in slightly acidic soils.	
Allophane is an example for volcanic origin, non-crystalline silicate clays.	
Soil pH is important because as soil pH decreases, CEC of the soil increases.	

(d) i. Is soil a renewable resource? Give reasons for your answer. (4 marks)

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ii. State the major difference between the material covering the surface of the moon and the material covering the land surface of the earth? (8 marks)

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- iii. Following is an excerpt from a news website which talks about the ISIS terrorist group. Why does the author use “Danger on U.S. Soil” in the title? (8 marks)



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(e) Write the correct answer to the each statement in the given space. (20 marks)

i. The soil order that results from the interaction of grassland vegetation and climate is ...	.....
ii. The diagnostic sub-surface horizon with accumulation of Sodium is....	.....
iii. Soils which are associated with volcanic ash/volcanic minerals are....	.....
iv. A man made diagnostic epi-pedon is.....	.....
v. A soil order that is found in Sri Lanka is.....	.....

2. a) i. Define a rock and a mineral. (10 Marks)
- ii. Indicate two (02) differences between Mafic silicates and Felsic silicates. (8 Marks)
- iii. Give two (02) example minerals each for Mafic silicates and Felsic silicates. (4 Marks)
- iv. List five (05) major structural types of silicate minerals with one example mineral for each. (10 Marks)

- b) i. What is the importance of studying rocks? (10 Marks)
- ii. List the three (03) types of rocks according to the method of formation. (6 marks)
- iii. Explain briefly the three (03) types of rocks which you mentioned in the part **b ii)**. (15 Marks).
- iv. What is the rock type which you can generally observe in fossils? What is the reason for your answer? (7 Marks)
- c) i. Define the term "weathering of rocks". (5 Marks)
- ii. What are the factors affecting weathering of rocks? (5 Marks)
- iii. "Any type of rock can be changed in to another type of rock"  
Justify this statement using the rock cycle. (20 marks)
3. a) i. What is meant by soil texture? (5 marks)
- ii. Name three methods that can be used to identify the texture of a soil. (5 marks)
- iii. State the advantages and disadvantages of the above mentioned methods. (15 marks)
- iv. Explain briefly the Stokes' law. (5 marks)
- v. Explain the assumptions used in the Stokes' law, and the limitations related to those assumptions. (25 marks)
- b) i. Define specific surface area (SSA). (5 marks)
- ii. Name the properties of soils that are affected by the SSA. (10 marks)
- iii. Explain the relation of the particle size to the SSA. Use examples and illustrations to justify your answer. (15 marks)
- iv. Explain the relation of the particle shape to the SSA. Use examples and illustrations to justify your answer. (15 marks)
4. a) i. Define soil colloids. (10 marks)
- ii. "All clay minerals are not strictly colloidal" Do you agree with this statement? Justify your answer. (10 marks)
- iii. State three differences between organic and inorganic colloids. (10 marks)

- b) i. Differentiate,
- a) A tetrahedron and an octahedron. (05 marks)
  - b) Cation exchange and isomorphous substitution. (05 marks)
- ii. Choose and write the characteristics belong to the each colloid. Colloids may possess more than one characteristic and any characteristic can apply to more than one colloid. (20 marks)

Colloid	Characteristics
Kaolinite	1:1 mineral/2:1 mineral
Smectite	Lowest CEC/Highest CEC
Vermiculite	Non expanding/ Expanding/ Limited expanding
Fine grained mica	No swelling/minimum swelling/some swelling/maximum swelling/No interlayer space/ minimum interlayer space/ some interlayer space/ highest interlayer space Layers are hydrogen bonded together

- c) i. What is meant by Base Saturation? (10 marks)
- ii. What are the predominant base forming cations and acid forming cations in soils? (5 marks)
- iii. What are the functional groups involved in pH dependent charges? (5 marks)
- iv. Explain how pH dependent charges (positive and negative) are generated in a clay mineral using an example. (20 marks)
5. a) i. Name two materials to which soil act as sink and a source. (10 marks)
- ii. Soil is considered as an ecosystem. Name the main component which enters the soil from the outside for it to become an ecosystem. (10 marks)
- b) i. It is said that most of the life in the soil is in the first few centimeters of the soil. What could be the reason for that? (10 marks)
- ii. Identify the organisms involved in the following associations. (15 marks)
- Algae
  - Mycorrhiza
  - Legume root nodules

- iii. Indicate the contribution of each organism for the associations mentioned above. (10 marks)
  - iv. Although termites are a troublesome when they enter our houses, they are an essential part of the ecosystem. Why is that? (10 marks)
- c) i. What is the importance of biodiversity for the proper functioning of the soil? (15 marks)
- ii. Explain the importance of a soil rich in biota and organic matter for the sustainability of agriculture. (20 marks)
6. a) i. What do you mean by soil horizons? (5 marks)
- ii. Sketch a typical soil profile with all the master horizons. (5 marks)
- iii. Explain briefly the formation of B horizon. (10 marks)
- iv. Explain the four (04) factors of "horizonation" (formation of soil horizons). (16 marks)
- b) i. How do the vegetation/living organisms affect soil formation? (10 marks)
- ii. Name three (03) natural diagnostic epi-pedons. (5 marks)
- iii. State the difference between Argillic (Bt) and Natric (Btn) sub-surface horizons. (4 marks)
- v. Explain briefly the soil order Gelisols. (10 marks)
- c) i. What are the equivalent USDA soil orders to the following Great Soil Groups in Sri Lankan classification? (15 marks)

Great Soil Groups	Equivalent USDA soil order
A. Reddish brown earths	
B. Regosols	
C. Alluvial	
D. Bog and half bog	
E. Red yellow podsolic	

- ii. Red Yellow Podsollic (RYP) soils are considered as the model soils of wet zone of Sri Lanka. Explain the characteristics of RYP soils. (20 marks)