JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS 2016/2017

SECOND YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN LAND RESOURCE PLANNING AND MANAGEMENT

ALP 2201: SOIL PHYSICS

DATE: DECEMBER 2016   TIME: 2 HOURS

INSTRUCTIONS

(a) Question 1 is compulsory and carries 60 marks

(b) Answer any TWO (2) questions from the three given questions (numbers 2 to 4). Each question carries TWENTY (20) marks.

Q1. <u>Compulsory Question carries a total of 60 Marks</u>

(a) Define soil structure and briefly discuss why good structural management is a prerequisite to enhanced agricultural productivity. **(10 Marks)**

(b) State Stoke's law and describe its use in the sedimentation process of particle-size analysis in the laboratory, stating its limitations. **(10 Marks)**

(c) Discuss the effects on infiltration rates of:

   (i)   Slope

   (ii)   Surface roughness, and

   (iii) Vegetation.

                                                   (6 Marks)

(d) A soil profile in its B horizon is found to have mottled colours of brown and grey. Briefly discuss the aeration status of this horizon, mentioning the possible chemicals that may be responsible for the mottled colours. **(6 Marks)**

(e) (i)   Using the phase interrelationships, prove the relationship between porosity, bulk density and particle density, i.e. $n = 1 - \dfrac{\rho b}{\rho s}$ **(4 Marks)**

(ii) The following data on soil suction against soil wetness was obtained for a certain soil using undisturbed samples.

Suction Head (cm)	% Volumetric Wetness of Soil
15,850 (w.?)	30.7 (1.47)
3,160 (3.5)	33.0 (1.52)
1,000 (3)	35.5 (1.55)
160 (2.2)	39.5 (1.59)
100 (2)	40.8 (1.6)
60 (1.7)	43.0 (1.65)
30 (1.47)	49.8 (1.69)
10 (1)	54.3 (1.73)
2.5 (0.34)	54.3 (1.73)
0 (0)	54.3 (1.73)

Plot a P^f curve and determine the:

(I) Volumetric wetness of the soil at field capacity and permanent wilting coefficient. (10 Marks)

(II) Bulk density of the soil, assuming the soil's particle density is 2.65 g/cm^3, and that the soil does not swell or shrink. (3 Marks)

(III) Water holding capacity of the soil in millimetres (mm) in a one (1) metre soil depth. (3 Marks)

(f) Differentiate:

(i) Temperature lag from temperature phase shift
(ii) Vapour flow from evaporation process
(iii) Hydrodynamic dispersion from diffusion of solutes
(iv) Hydraulic conductivity from infiltration process

(8 Marks)

Answer any TWO (2) Questions from Question Numbers 2 to 4

Q2 (a) (i) List the causes of seasonal variation of soil temperatures. (2 Marks)

(ii) Discuss how the thermal regime of the soil can be modified by changing the thermal properties of the soil. (8 Marks)

(b) (i) Describe the use of electrical resistance blocks for determining soil water in the field.

(6 Marks)

(ii) State the advantages and disadvantages of using the method in b (i) above. (4 Marks)

Q3 (a) (i) Explain two possible causes of poor aeration in soils. (2 Marks)

(ii) Give Fick's law for the diffusion process of gaseous exchange, defining all the symbols therein. (3 Marks)

(iii) Discuss mass transfer of gases in soils and with reasons state the main differences between this process and that of diffusion. (5 Marks)

(b) (i) List the limitations of the convective solute transport process. (4 Marks)

(ii) Define tortuosity and discuss its effect during the diffusion process of solute movement. (6 Marks)

Q4 (a) Briefly describe saturated water movement in soils. Of what use is this process in land resource management? (8 Marks)

(b) (i) Distinguish the four broad textural classes of soils found world-wide. (4 Marks)

(ii) Briefly outline the importance of knowledge of soil texture in soil management for agricultural productivity. (8 Marks)

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