



University of Fort Hare  
*Together in Excellence*

**UNIVERSITY OF FORT HARE**

**SOIL PHYSICS**

**DEGREE EXAMINATIONS**

**NOVEMBER 2016**

**TIME: 3 HOURS**

**SUBJECT: AGS 422**

**MARKS: 100**

**This paper consists of 3 pages including cover page**

**INTERNAL EXAMINER**  
**EXAMINER**

**MR I GURA**

**DR A MANYEVERE**

**EXTERNAL**

**PROF JJO ODHIAMBO**

**INSTRUCTIONS**

**ANSWER ALL THE QUESTIONS**

### QUESTION 1 (25 marks)

(a) Prove each of the following relationships if  $e$  = void ratio;  $f$  = porosity;  $f_a$  = air filled porosity;  $s$  = degree of saturation :

$$(i) e = f / (1 - f) \quad [5]$$

$$(ii) f_a = f (1-s) \quad [5]$$

(b) 180-cm<sup>3</sup> soil sample was collected three days after a drenching rain when the soil was assumed to be at field capacity. The wet weight of the sample was 274.1 g and after drying overnight in an oven the sample weighed 214.7g. Assume particle density is 2.65g cm<sup>-3</sup>. Calculate its:

(i) Bulk density [3]

(ii) Porosity [4]

(iii) Volumetric water content and gravimetric water content [5]

(iv) What fraction of the soil's pore space is filled with water at field capacity?

[3]

### QUESTION 2 (25 marks)

(a) Using the relationship  $v = d^2 (P_s - P_w) g / 18 \eta$  for terminal velocity of particles falling in a viscous fluid by their own weight due to gravity, derive equations to calculate

(i) Diameter of particles ( $d$ ) [2]

(ii) Density of water ( $P_w$ ) [3]

(iii) Density of particles ( $P_s$ ) [3]

(iv) Viscosity of water ( $\eta$ ) [2]

(b) Using Stoke's law, calculate the time needed for all the sand (> 0.05 mm), silt (> 0.002 mm) and clay (> 0.0002 mm) to settle to a 10 cm depth in an aqueous suspension at 20 °C. Given that the acceleration due to gravity is 981 cm s<sup>-2</sup>, viscosity is 0.01002 Pascal-second (i.e. g/ cm-second), the mean particle density is 2.65 g cm<sup>-3</sup> and density of water is 0.99823 g cm<sup>-3</sup> [15]

**QUESTION 3 (10 marks)**

- (a) Name the physical states of water [2]
- (b) Name the mechanism that triggers a change in the physical state of water [2]
- (c) Describe the effect of the change of the physical state of soil water on soil temperature [6]

**QUESTION 4 (15 marks)**

- (a) Describe the occurrence of soil compaction and crusting in agricultural soils [10]
- (b) Explain how soil compaction and crusting can be prevented and controlled [5]

**QUESTION 5 (10 marks)**

Sketch a graph to illustrate the relationship between:

- (a) The soil water content and suction in soils with high and low bulk density [5]
- (b) Infiltration rate and time in stable and unstable soils [5]

**QUESTION 6 (15 marks)**

- (a) Define each of the following terms:
  - (i) volumetric heat capacity [3]
  - (ii) Thermal conductivity [3]
  - (iii) Thermal diffusivity [3]
- (b) Write an equation to show the relationship between volumetric heat capacity, thermal conductivity and thermal diffusivity [6]

*The End*

