



# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT BUILDING AND CIVIL ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

**BSC IN CIVIL ENGINEERING**

**ECE 2311: SOIL MECHANICS II**

**END OF SEMESTER EXAMINATION**

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE: 09 May 2016**

## Instructions to Candidates

You should have the following for this examination

*-Answer Booklet, Drawing Instruments, Scientific calculator, examination pass and student ID*

This paper consists of five questions. Attempt question ONE (Compulsory) and any other TWO questions.

### **Question One (Compulsory)**

**(30 marks)**

- a) The footings of sizes 4m x 4m and 3m x 3m are placed 9m centre to centre apart at the same level and carry loads of 250 kg and 220 kg respectively. Compute the vertical pressure at a depth of 5m at point C midway between the centers of the footings. **(8 marks)**
- b) Using illustrations, discuss the various causes of failure of slopes. **(10 marks)**
- c) Outline the shearing characteristics of a soil. **(4 marks)**
- d) An unconfined cylindrical specimen of clay fails under an axial stress of 240 kN/m<sup>2</sup>. The failure plane is inclined at an angle of 55° to the horizontal. Determine the shear strength parameters of the soil. **(6 marks)**

- e) Define shear strength of soil. (2 marks)

**Question Two**

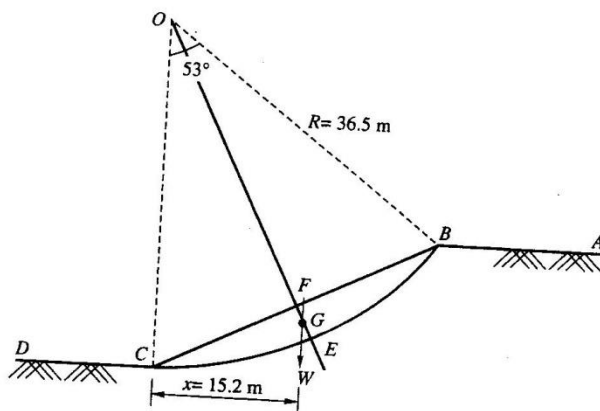
**(20marks)**

- a) A concentrated load of 400kN acts at foundation level at a depth of 2m below ground surface. Compute the vertical stress along the axis of the load at a depth of 10m and at a distance of 5m at the same depth by (i) Boussinesq and (ii) Westergaard formulae for  $\mu = 0$ . Neglect the depth of the foundation. (8marks)
- b) With the aid of sketches, discuss the different types of circular surfaces failure. (10marks)
- c) State the FOUR most important factors upon which  $c$  and  $\sigma$ , in Coulomb's equation depend (2marks)

**Question Three**

**(20marks)**

- a) Briefly describe the Direct Shear test for determining shear strength parameters of a soil. (12 marks)
- b) Calculate the factor of safety against shear failure along the slip circle shown in the fig. below. Assume cohesion =  $35\text{kN/m}^2$ , angle of internal friction = zero and total unit weight of the soil =  $20\text{kN/m}^3$ . (5marks)



**Fig. Ex. 16.6**

- c) Explain the assumptions used in Boussinesq's formula for point loads. (3marks).

**Question Four****(20marks)**

- a) Determine by Culmann's method the critical height of an embankment having a slope angle of  $40^\circ$  and the constructed soil having  $C' = 650\text{kN/m}^2$ ,  $\phi = 20^\circ$  and effective unit weight =  $120\text{kN/m}^3$ . Find the allowable height of the embankment if  $F_c = F\phi = 1.25$  **(6 marks)**
- b) What will be the factors of safety with respect to average shearing strength, cohesion and internal friction of a soil, for which the shear strength parameters obtained from the laboratory tests are  $C' = 45\text{kN/m}^2$  and  $\phi' = 18^\circ$ . The expected parameters of mobilized shearing resistance are  $c_m' = 21\text{kN/m}^2$  and  $\phi_u'$  and the average effective pressure on the failure plane is  $120\text{kN/m}^2$ . For the same value of mobilized shearing resistance, determine:
- (i) Factor of safety with respect to height
  - (ii) Factor of safety with respect to friction when that with respect to cohesion is unity.
  - (iii) Factor of safety with respect to strength. **(10marks)**
- c) Explain soil stabilization. **(4marks)**

**Question Five****(20marks)**

- a) Briefly describe the various types of admixtures used in soil stabilization. **(8 marks)**
- b) Find the factor of safety of a slope of infinite extent having a slope angle of  $25^\circ$ . The slope is made of cohesion less soil with  $\phi' = 30^\circ$ . **(2marks)**
- c) Analyze the same slope if it is made of clay having  $C' = 30\text{kN/m}^2$ ,  $\phi' = 20^\circ$ ,  $e = 0.65$  and  $G = 2.7$  under the following conditions:
- i) When soil is dry
  - ii) When water seeps parallel to the surface of slope
  - iii) When slope is submerged **(10 marks)**