EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

CIVIL ENGINEERING DEPARTMENT

FINAL EXAMINATION
JUNE 2012 SESSION

CC502 : GEOTECHNICS 2

DATE : 22 NOVEMBER 2012
DURATION : 2 HOURS (8.30 -10.30 AM)

This paper consists of EIGHT (8) pages including the front page.
Section A: Essay (1 questions – answer ALL)
Section B: Essay (5 questions – answer 3 questions)

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THE CHIEF INVIGILATOR

(The CLO stated is for references only)
SECTION A (COMPULSORY)
ESSAY QUESTION (25 marks)

INSTRUCTION:
This section consists of ONE (1) essay question only. You are required to answer the question.

QUESTION 1

a) State FIVE (5) objectives of Site Investigation. [CLO 1] (5 marks)

b) Explain briefly the following stages of Site Investigation. [CLO 1]

i. Site Reconnaissance (3 marks)
ii. Planning a site investigation (3 marks)
iii. Ground Exploration (3 marks)
iv. Laboratory Test (3 marks)

c) Give FOUR (4) advantages and FOUR (4) common errors in conducting the Probe Mackintosh Test. [CLO 1] (8 marks)
SECTION B
ESSAY QUESTION (75 marks)

INSTRUCTION:
This section consists of FIVE (5) essay questions. Answer THREE (3) questions only.

QUESTION 1

a) Figure 1 shows a sheet piling in a sandy soil impounding upstream water. If the coefficient of permeability \((k)\) is \(7.2 \times 10^{-3}\) mm/sec: [CLO 2]

i. Redraw the diagram using an appropriate scale and plot the flow net. It must contain equipotential lines, \(N_e\) and flow lines, \(N_f\).

ii. Determine the quantity of seepage, \(Q\) in m\(^3\)/hour/m length.

iii. Calculate the pore water pressure at point \(P\).

(18 marks)
b) Determine factor of safety against sliding shown in Figure 2 using the Total Stress Analysis Method. [CLO2]

Given:

\[ \begin{align*}
\gamma &= 18 \text{ kN/m}^3 \\
c &= 35 \text{ kN/m}^2 \\
A &= 175 \text{ m}^2 \\
\theta &= 83.1^\circ \\
\phi &= 0 \\
d &= 7.3 \text{ m} \\
R &= 22.83 \text{ m}
\end{align*} \]

Figure 2
QUESTION 2

a) State TWO (2) types of retaining wall [CLO 2]
   (2 marks)

b) Rankine (1857) had developed a theory to calculate the lateral active and passive pressure. Give THREE (3) assumptions from the Rankine theory. [CLO 2]
   (3 marks)

c) Analyze the safety factor of the maximum bearing capacity for the cantilever retaining wall as shown in Figure 3. [CLO2]
   (20 marks)

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**Figure 3**

Given:
- Soil bearing capacity = 215 kN/m²
- \( \gamma_{\text{concrete}} = 24 \text{ kN/m}^3 \)
- \( \mu = 0.70 \)
- \( \gamma_{\text{soil}} = 19 \text{ kN/m}^3 \)
- \( \varphi = 20^\circ \)
- \( \gamma_{\text{sat}} = 21 \text{ kN/m}^3 \)
QUESTION 3

a) Foundation normally refers to something that supports a structure such as column or wall, along with the loads carried by the structure. State THREE (3) main design criteria to be considered for a concrete footing. [CLO 1] (6 marks)

b) Name and sketch THREE (3) types of shallow foundation. Give a short explanation for each. [CLO 1] (9 marks)

c) Explain the FIVE (5) successive steps that the design engineer must perform in choosing the type of foundation. [CLO 2] (10 marks)
QUESTION 4

a) Sketch TWO (2) types of soil shear failure mode and explain them briefly.

[CLO 2]  
(10 marks)

b) A square footing (2m x 2m) is located at a depth of 5m below the ground surface to distribute the load from the structure. The parameters of the soil are given below;

[CLO2]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit weight of soil, $\gamma$</td>
<td>$19 \text{ kN/m}^3$</td>
</tr>
<tr>
<td>Unit weight of saturated soil, $\gamma_{sat}$</td>
<td>$21 \text{ kN/m}^3$</td>
</tr>
<tr>
<td>Cohesion of soil, $C$</td>
<td>$55 \text{ kN/m}^2$</td>
</tr>
<tr>
<td>Friction angle of soil, $\phi$</td>
<td>$15^0$</td>
</tr>
<tr>
<td>Ground water level, GWL</td>
<td>Water table at the surface of soil</td>
</tr>
</tbody>
</table>

Calculate;

i. the ultimate bearing capacity of the soil

ii. the factor of safety (SF) if the design load from the structure, $Q$ is $1500\text{kN}$.

(15 marks)
QUESTION 5

a) State and explain the meaning of the formula for the ultimate Bearing Capacity of pile and pile foundation. [CLO2] (5 marks)

b) State THREE (3) reasons why Pile Load Test is required for the design of piles. [CLO2] (6 marks)

c) Piles are classified according to various criteria. List TWO (2) types of piles for each of the following criteria:
   i. Pile Installation Method
   ii. Load Transfer Method [CLO 2] (4 marks)

d) Explain briefly the bearing capacity of piles. [CLO 2] (5 marks)

e) Explain Negative Skin Friction with the aid of a diagram. [CLO 2] (5 marks)