ZIMBABWE

MINISTRY OF HIGHER AND TERTIARY EDUCATION, INNOVATION, SCIENCE AND TECHNOLOGY DEVELOPMENT

HIGHER EDUCATION EXAMINATIONS COUNCIL (HEXCO)

NATIONAL CERTIFICATE

IN

CIVIL ENGINEERING

MODULE: Geotechnical Engineering **PAPER NO: 313/22/M05**

DURATION: 3 Hours

MAY/JUNE 2025 EXAMINATION

REQUIREMENTS

Calculator, graph paper, semi logarithmic sheet

INSTRUCTIONS TO CANDIDATE

1) **Answer any three (3) questions from question 1-4 and answer question five (5).**

2) **Question 1-4 carry equal marks and question five (5) carries 40 marks.**

3) **Start each question on a new page.**

4) **Do not write anything on the question paper.**

This paper consists of 5 printed pages.

QUESTION 1

A laboratory test carried at an undisturbed sample of soil weighing 1,74kg and having a volume of $^{1}/_{1000m^2}$ determined the specific gravity of the solids to be 2,6 and the dry density of the soil to be 1500 kg/m^3

Calculate

a) The moisture content (4 marks)

b) The void ratio and porosity (6 marks)

c) The critical hydraulic porosity (2 marks)

d) The saturated and submerged densities (6 marks)

e) The degree of saturation of the soil (2 marks)

QUESTION 2

a) Briefly describe the following:

i) Protector compaction test (5 marks)

ii) Dynamic cone penetration (5 marks)

b)

Retained on sieve size (mm)	20	12,5	10	6,3	5,6	2,8	2	1,4	0,5	0,355	0,180	0,063
Weight retained	0	1,7	2,3	8,4	5,7	12,9	3,5	1,1	30,5	45,3	25,4	7,4

The total weight of the sample was 147,2g

i) Plot the particle size distribution curve and describe the soil (7 marks)

ii) State the effective grain size (1 mark)

iii) Find the Allen Hazen uniformity coefficient. (2 marks)

QUESTION 3

a) Explain the following techniques (methods) of determining permeability on site:

i) Borehole techniques (4 marks)

ii) Wellpoint techniques (4 marks)

b) A shear test carried out on a sandy day gave the following results:

Vertical load	36,8	73,5	110,2	146,9
Divisions of proving ring dial gauge (one division to	17	26	35	44

If the shear box is 60mm square and the proving ring constant 20N/ μm, determine the apparent cohesion and the angle of internal friction for this soil. (12 marks)

QUESTION 4

a) Explain how you would determine the specific gravity of a soil under laboratory conditions. (6 marks)

b) Tabulate the Casagrande system of soil classification and state where the system is used. (6 marks)

c) Define the following terms:

i) Liquid limit (2 marks)

ii) Elastic limit (2 marks)

iii) Shrinkage limit (2 marks)

QUESTION 5

a) State the characteristics of minerals and briefly explain each characteristic. (10 marks)

b) With the aid of diagrams describe the following:

i) Fold (5 marks)

ii) Fault (5 marks)

c) Discuss the formation of the following types of rock:

i) Sedimentary (5 marks)

ii) Igneous Rocks (5 marks)

d) Describe how coral reefs are formed and outline the types of coral reefs of your choice. (10 marks)