



THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

Department of Civil Engineering

SECOND SEMESTER EXAMINATION

Second Year Bachelor of Civil Engineering (Honours)

Subject Code: **CE221**

Subject Name: **Soil Mechanics and Geology**

Date: **1st November, 2021**

Time: **12:50 pm to 4:00 pm**

Venue: **Structures Lecture Theatre (SLT)**

Examination Instructions

1. **NO MOBILE PHONE** is allowed in the examination room.
2. You have 10 minutes to read the paper.
3. Fill-in the attendance slip. **DO IT NOW.**
4. **ANSWER SEVEN (7) QUESTIONS ONLY.**
5. Write your answer in the answer booklet provided.
6. Do not consult your notes. Students caught cheating will be removed from the examination room and will get a zero mark.

GEOLOGY

Question 1

- (a) Three broad rock groups are distinguished, on the basis of their origins rather than their composition or strength: Name these rock groups and explain how each of these rocks were derived or formed? (10 marks)
- (b) State the major rock groups of the following rocks;
- (i) Granite pegmatite
 - (ii) Limestone
 - (iii) Shale
 - (iv) Sandstone
 - (v) Gneiss
- (5 marks)

Question 2

- (a) Earthquakes range from slight tremors which do little damage, to severe shocks which can open fissures in the ground, initiate fault scarps and landslides, break and overthrow buildings, and sever supply mains and lines of transport.
- (i) What types of soils experiences the worst effect of an earthquake? (5 marks)
 - (ii) How can you design and build earthquake resisting structures? (5 marks)
- (b) In a geotechnical site investigation report, you are required to name the plate boundaries of the area you are investigating. In terms of plate tectonics, Papua New Guinea is separated by which two major tectonic plates? Name them. (2 marks)
- (c) These plates were free to move with respect to the underlying asthenosphere, and could also move relatively to one another in three ways. Describe those three ways. (3 marks)

Question 3

- (a) How are clay minerals formed? (5 marks)
- (b) Name the four main groups of clay minerals and describe the nature and structure of clay minerals. (5 marks)
- (c) State the important properties of clay minerals in terms of engineering point of view. (5 marks)

SOIL MECHANICS

Question 4

Gravels, sands and peats are easily recognisable, but difficulty arises in deciding when a soil is a fine sand or a coarse silt or when it is a fine silt or a clay. Give five descriptions of keys each for identifying fine sand, silt and clay.

(15 marks)

Question 5

(a) A sample of soil was placed in a water content tin of mass 20.52 g. The combined mass of the soil and the tin was 49.27 g. After oven drying the soil and the tin had a mass of 43.31 g. Determine the water content of the soil. (5 marks)

(b) The results of a sieve analysis on a soil sample were:

Sieve size (mm)	Mass retained (g)
10	0.0
6.3	5.5
2	25.7
1	23.1
0.6	22.0
0.3	17.3
0.15	12.7
0.063	6.9

2.3 g passed through the 63 μm sieve.

Plot the particle size distribution curve and determine the uniformity coefficient of the soil.

(10 marks)

Question 6

In standard compaction test the following data were collected:

Water content (%)	5	8	10	13	16	19
Bulk density (Mg/m^3)	1.87	2.04	2.13	2.20	2.16	2.09

$$G_s = 2.70$$

Determine the maximum dry density and the optimum moisture content of the soil.

(10 marks)

Why do you determine the maximum dry density and optimum moisture content of the soil from a soil compaction test?

(5 marks)

Question 7

- (a) A sample of wet soil was extruded from a sampling tube of diameter 100 mm in a soil testing laboratory. The length of extruded sample was 200 mm. The mass of the wet soil was 3.15 kg. Following a water content determination, the mass of the dry soil was found to be 2.82 kg.

Determine the bulk density, water content, dry density and dry unit weight of the soil.
(5 marks)

- (b) In a bulk density determination, a sample of clay with a mass of 683 g was coated with wax. The combined mass of the clay and the wax was 690.6 g. The volume of the clay and the wax was found, by immersion in water, to be 350 ml. The sample was then broken open and water content and particle specific gravity tests gave respectively 17% and 2.73. The specific gravity of the wax was 0.89. Determine the bulk density and unit weight, void ratio and degree of saturation.

(10 marks)

Question 8

- (a) Define the following terms in soil permeability and flow of water in soil;

(i) Aeration zone

(ii) Saturation zone

(4 marks)

- (b) How do you derive the hydrostatic head for the flow of water in soil or seepage problem?

(6 marks)

- (c) How do you determine the coefficient of permeability?

(5 marks)

END OF EXAMINATION