



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015**

COURSE NAME : ENGINEERING GEOLOGY
COURSE CODE : BFC 21303 / BFC 3013
PROGRAMME : 2 BFF / 3 BFF
EXAMINATION DATE : DECEMBER 2014/JANUARY 2015
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER Q1 IN PART A
2. ANSWER ANY **THREE (3)**
QUESTIONS IN PART B

THIS QUESTION PAPER CONSISTS OF SEVEN(7) PAGES

PART A

Q1 (a) Briefly explain the discontinuity characteristics that should be recorded in the assessment of the rock slope stability.

(5 marks)

(b) The parameters of rock cut slope were investigated and tabulated in **Table 1**. A discontinuity survey was conducted along the cut slope and results for the discontinuity sets orientations are given in **Table 2**. A study of the joint sets showed that all joint surfaces had a friction angle of 30° .

Table 1

Slope dip direction	= 90°
Slope face angle	= 70°
Height of rock slope	= 50 m
Depth of tension cracks	= 5 m
Unit weight of the rock	= 25 kN/m^3
Unit weight of water	= 9.81 kN/m^3
Cohesion of the discontinuity	= 100 kPa
Friction angle for the discontinuity	= 30°

Table 2

Joint set 1	Joint set 2	Joint set 3	Joint set 4	Joint set 5
$90^\circ/20^\circ$	$90^\circ/40^\circ$	$260^\circ/55^\circ$	$45^\circ/65^\circ$	$140^\circ/40^\circ$

(i) Analyse the entire failure mode of the rock slope as well as the criterion as an evidence using Figure **Q1b(i)**.

(8 marks)

(ii) Calculate the factor of safety for planar failure mode using formula in Figure **Q1b(ii)** when the tension crack is completely filled with water. Calculate the force needs to be applied by an anchor to increase the factor of safety to 1.5 (inclination of anchor at 20°).

(8 marks)

(iii) To avoid the rock slope failure, one of the option is changing the slope dip direction. Recommend **ONE (1)** new slope dip direction without changing the slope face angle and justify your answer.

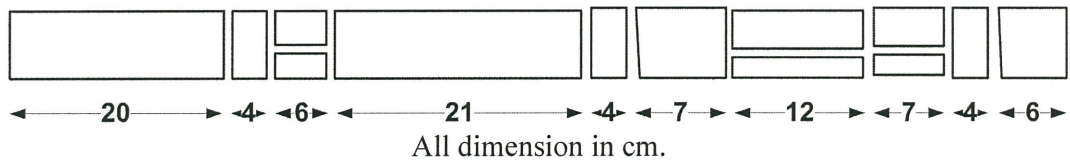
(4 marks)

PART B

- Q2** (a) Briefly describe the lithosphere and asthenosphere layer. (4 marks)
- (b) Briefly describe the tectonism process that changes the earth's structure. (4 marks)
- (c) Draw simple sketches of divergent plate boundaries, three kinds of convergent plate boundaries, and transform plate boundaries. (6 marks)
- (d) Explain the concentration of earthquakes and volcano activity to support the theory of tectonic plate (6 marks)
- (e) Explain the factor of the rock composition in controlling the rate of weathering via giving the rock examples. (5 marks)

- Q3** (a) Explain the principle of seismic refraction techniques. (4 marks)

- (b) The standard length of the rock core was 1.5 m for each sequence of the rock drilling work. Calculate the Rock Quality Designation (RQD), Total Core Recovery (TCR) and Solid Core Recovery (SCR) for the obtained rock sample below.



- (c) Explain the differences of the results between:
- (i) Uniaxial compression test and point load test
 - (ii) Uniaxial Compressive Strength (UCS) and Joint Surface Compressive Strength (JCS)
 - (iii) Brazilian test and Portable Ultrasonic Non-destructive Indicator test
 - (iv) Loess and alluvium
 - (v) Oxidation and dissolution in weathering
- (12 marks)

- (d) Explain the reasons of the point load test is considered an indirect strength test.
(3 marks)
- Q4** (a) Explain the characteristics of weathering product grade 3 and 4 which fall on the categories of the soil and rock like.
(4 marks)
- (b) With the aid of suitable diagrams, explain the differences between:
- i) Fault and Fold
 - ii) Anticline and Monocline
 - iii) Strike slip fault and Normal dip slip fault
- (6 marks)
- (c) Outline the rock cycle with the aid of an appropriate sketch and briefly describe the associated geological processes
(5 marks)
- (d) Explain the reasons of the sediments deposition, which cause the shallowing of the river bed.
(4 marks)
- (d) Predict the textures and/or structures that could cause the weakness to civil engineering structures in (a) igneous rock, (b) sedimentary rock, and (c) metamorphic rock.
(6 marks)
- Q5** (a) Explain the differences between:
- i) Color and streak in mineral identification.
 - ii) Cleavage and fractured in mineral
 - iii) Gabbro and basalt in igneous rocks
 - iv) Arkose sandstone and greywacke sandstone
 - v) Organic and inorganic sedimentary rocks
 - vi) Contact metamorphism and dynamic metamorphism
- (12 marks)

- (b) Explain the differences of rock textures which exist in igneous, sedimentary and metamorphic rocks.

(5 marks)

- (c) A notable characteristic of metamorphic rocks is its foliation. With the aid of suitable sketches, describe the different types of foliation found in metamorphic rocks.

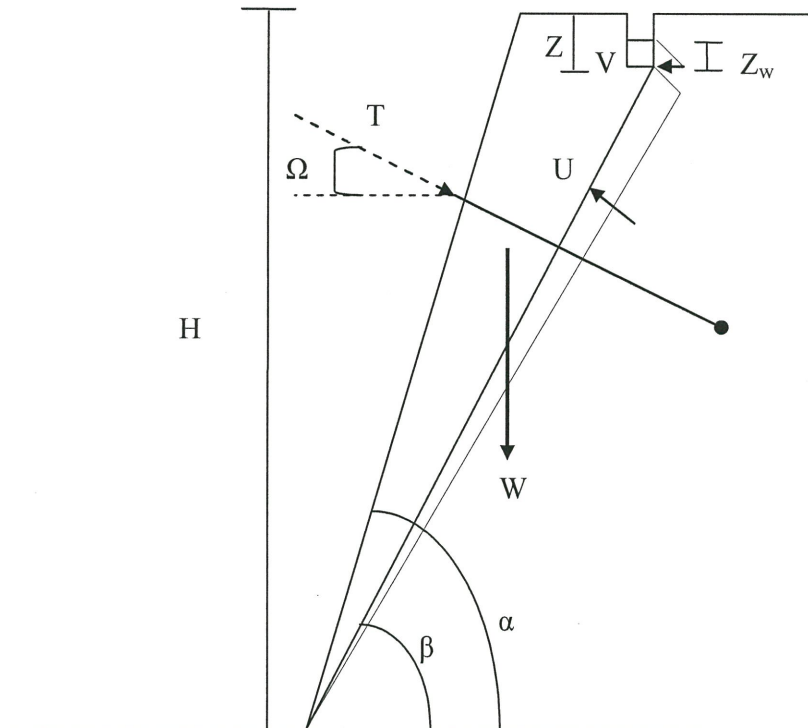
(8 marks)

-END OF QUESTIONS-

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Given:

$$\text{FOS} = \frac{cA + [W \cos\beta - U - V \sin\beta + T \sin(\Omega + \beta)] \tan\phi}{W \sin\beta + V \cos\beta - T \cos(\Omega + \beta)}$$

$$A = (H-Z) \cdot \text{cosec } \beta$$

$$W = \frac{1}{2} \gamma_r H^2 \left[\left(1 - \left(\frac{Z}{H} \right)^2 \right) \cot\beta - \cot\alpha \right]$$

$$U = \frac{1}{2} \gamma_w Z_w \cdot (H-Z) \cdot \text{cosec } \beta$$

$$V = \frac{1}{2} \gamma_w Z_w^2$$

$$\text{cosec } \beta = \frac{1}{\sin \beta}$$

$$\sec \beta = \frac{1}{\cos \beta}$$

$$\cot \beta = \frac{1}{\tan \beta}$$

FIGURE Q1 (b)(i)

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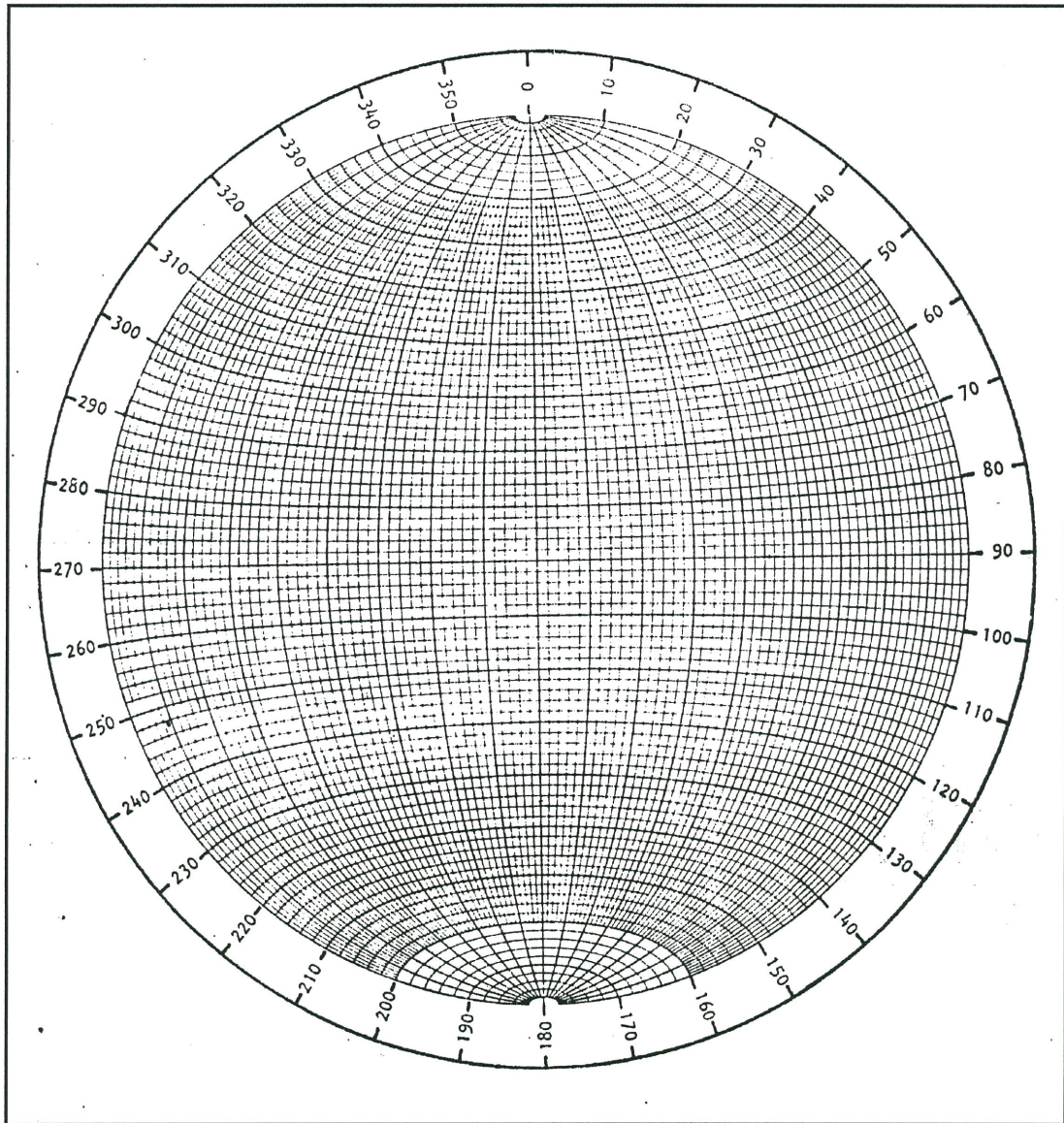


FIGURE Q1(b)(ii): Equatorial equal-area stereo-net marked in 2° intervals