Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	GEOLOGY ENGINEERING
COURSE CODE	:	BFC 21303
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	1.	ANSWER ALL QUESTIONS
	2.	THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.**
	3.	STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 A railway track cutting 60 m deep is driven through a granite rock formation. The rock slope face cutting in the direction of 260^0 and dip angle 70^0. The rock slope has been mapped and analysed. **Table Q1** summarized the data of discontinuity sets, slope geometry and rock parameters.

(a) Analyse the entire rock slope failure modes using **Figure Q1(a)** with its criterion based on **Table Q1(a)**.

(6 marks)

(b) Calculate the factor of safety for the planar failure mode using the formula in **Figure Q1(b)** when the tension crack is completely filled with water. Calculate the required anchor bars to stabilize the rock slope to factor of safety 1.5.

(6 marks)

(c) Calculate the factor of safety for wedge failure mode using the formula in **Figure Q1(c)** when the tension crack is completely filled with water.

(8 marks)

(d) Recommend a new rock slope dip angle in order to avoid potential any rock slope failure modes and predict the consequences of the recommendation.

(5 marks)

Q2 (a) Explain **FIVE (5)** information that could be obtained from the boring operation in the site investigation.

(5 marks)

(b) Discuss the outcome between the borehole standard penetration test number of blows (SPT N-blows) and seismic refraction velocity for determine the ground profile.

(5 marks)

(c) Explain the outcome from the comparison of ultrasonic velocity result conducted on core samples in the laboratory and seismic refraction test conducted in the field.

(5 marks)

(d) At site X, the electrical resistivity tomography shows the granitic bedrock has 50 ohm.m. However, at site Y, the granitic bedrock has 5000 ohm.m. Explain the factors of this differences of resistivity values of granitic bedrock at site X and Y.

(5 marks)

(e) The force directional angle towards foliation affects the rock strength. Explain this statement.

(5 marks)

Q3 (a) Discuss **FIVE (5)** evidences that indicate the lithosphere is fragmented and slowly moving relatively apart.

(5 marks)

(b) Discuss the problem encountered while identify the mineral using physical properties such as colour, cleavage and fracture, lustre and streak techniques.

(5 marks)

(c) Extrusive igneous rock is solidified magma on the surface or near the surface. Discuss the differences between basalt and rhyolite.

(5 marks)

(d) Differentiate the inorganic and organic chemical sedimentary rocks.

(5 marks)

(e) Explain how to differentiate between sandstone and quartzite.

(5 marks)

Q4 (a) One borehole was drilled at site X denoted as BH1 as shown in **Figure Q4(a)**. Rock coring at length of 1500 mm. Calculate the rock quality designation, the total core recovery and the solid core recovery.

(5 marks)

(b) Sketch the typical weathering profile for granitic and metamorphic rock formations.

(5 marks)

(c) Discuss the ductile mode of rock deformation and relate with the overturned anticline and syncline structures.

(5 marks)

(d) Quartz, feldspars and mica minerals are dominants minerals in the granitic rock formation. When the river flowing through the granitic rock, huge amount of quartz more than 90% at sand size deposited at river bed. It indicates nearly absence of felspars and mica. Explain this phenomenon.

(5 marks)

(e) Cenozoic era is less than 2 million years and its sediment known as Quaternary deposit. Meanwhile sedimentary formation such as Kenny Hill formation is formed around 345 million years ago. Discuss the characteristic of ground that made of Quaternary deposit compared with ground of Kenny Hill formation in Peninsular Malaysia.

(5 marks)

- END OF QUESTIONS -

FINAL EXAMINATION

SEMESTER/SESSION : SEM II 2021/2022
COURSE NAME : GEOLOGY ENGINEERING
PROGRAMME CODE : BFF
COURSE CODE : BFC 21303

Table Q1: Parameter of granite rock slope

Parameters	Values
Joint set 1 (dip direction/dip angle)	75°/60°
Joint set 2 (dip direction/dip angle)	250°/46°
Joint set 3 (dip direction/dip angle)	320°/70°
Joint set 4 (dip direction/dip angle)	260°/10°
Slope face dip direction	260°
Slope face angle (slope angle)	70°
Upper slope face dip direction	260°
Upper slope face angle	0°
Height of slope / wedge	60 m
Unit weight of the rock	25 kN/m^3
Depth of tension crack	3 m
Unit weight of water	9.81 kN/m^3
The cohesion of all discontinuities	100 kPa
Friction angle for all discontinuities	30°
Inclined angle of anchor (Ω) = (ψ_T)	20°
Bars for Y25	10 ton = 100 kN

FINAL EXAMINATION

SEMESTER/SESSION : SEM II 2021/2022
COURSE NAME : GEOLOGY ENGINEERING
PROGRAMME CODE : BFF
COURSE CODE : BFC 21303

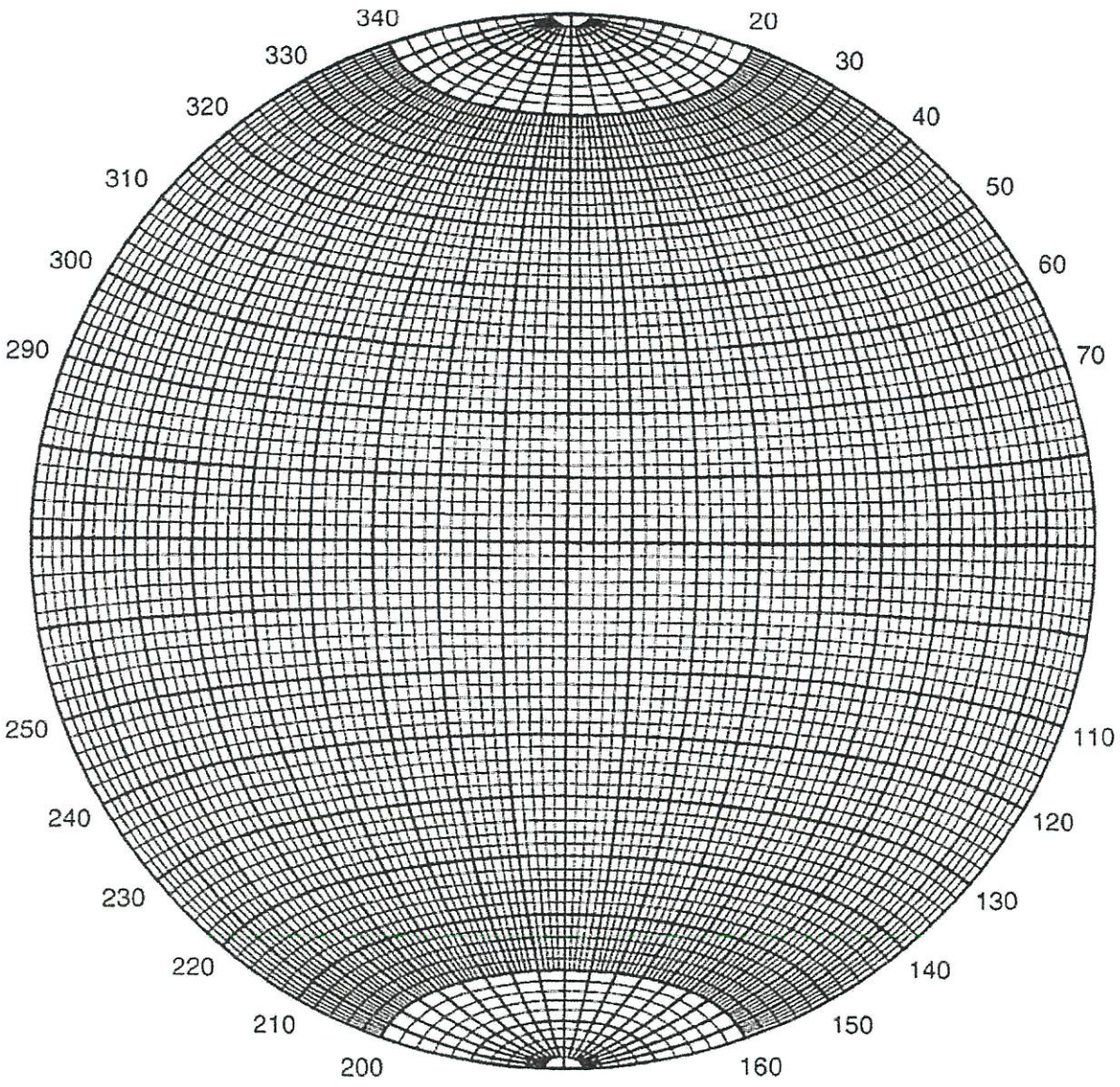


Figure Q1(a): Equatorial equal-area stereo-net marked in 2° intervals

FINAL EXAMINATION

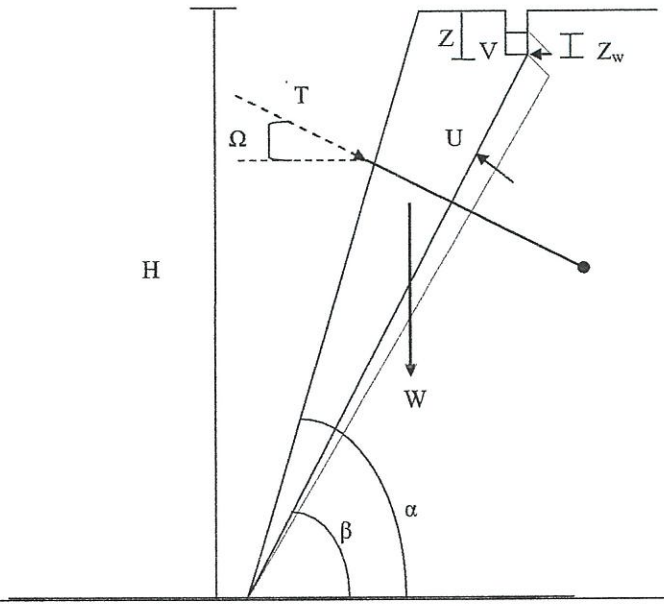
SEMESTER/SESSION : SEM II 2021/2022
COURSE NAME : GEOLOGY ENGINEERING
PROGRAMME CODE : BFF
COURSE CODE : BFC 21303

Table Q1(a): Parameter of granite rock slope

Modes of failure	Criteria are met
Circular	i. Very weak material, highly jointed or fractured or weak soil ii. Homogenous soil
Planar	i. The dip direction of the joint must be laid within ± 20^0 from the slope dip direction. ii. $\psi_f > \psi_p > \phi$ (slope angle> plane angle > friction angle) iii. Release surfaces must be present to define the lateral boundaries of the slide.
Wedge	i. $\psi_f > \psi_i > \phi$ (slope angle > the intersection angle of 2 joints > friction angle)
Toppling	i. The dip direction of the joint must be laid between ±10° in the opposite direction of the slope dip direction. ii. $(90^0 - \psi_f) + \phi \leq \psi_t$

FINAL EXAMINATION

SEMESTER/SESSION : SEM II 2021/2022
COURSE NAME : GEOLOGY ENGINEERING
PROGRAMME CODE : BFF
COURSE CODE : BFC 21303



Given:

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

A= failure plane area
c = cohesion
W = weight of failure block
β =failure plane angle
H = height of plane
T = tension of anchor
γ_r= unit weight of rock
ϕ = friction angle
U = vertical water pressure
V = horizontal water pressure
α = slope angle
Z = tensional cracks
Ω = inclined angle of anchor
γ_w= unit weight of water

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

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

$U = \tfrac{1}{2}\gamma_w.Z_w.(H-Z).\text{cosec}\,\beta$

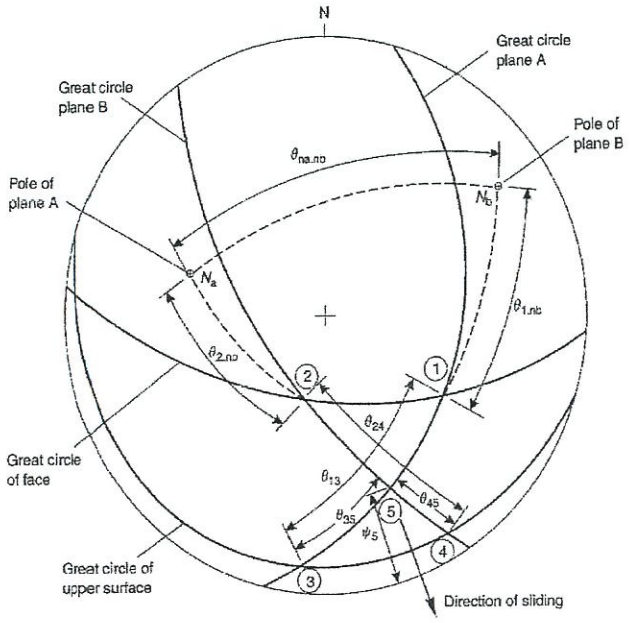
$V = \tfrac{1}{2}\gamma_w.Z_w^2$

$$\text{cosec}\beta = \frac{1}{\sin\beta} \quad \sec\beta = \frac{1}{\cos\beta} \quad \cot\beta = \frac{1}{\tan\beta}$$

Figure Q1(b): Planar failure mode formula

FINAL EXAMINATION

SEMESTER/SESSION : SEM II 2021/2022
COURSE NAME : GEOLOGY ENGINEERING
PROGRAMME CODE : BFF
COURSE CODE : BFC 21303



Given:

$$Fos = \frac{3}{\gamma H_t}(C_a.X + C_b.Y) + (A - \frac{\gamma_w}{2\gamma}.X)Tan\phi_a + (B - \frac{\gamma_w}{2\gamma}.Y)Tan\phi_b$$

C_a = Cohesion
ϕ_b = Friction angle
H_t = height of wedge
ψ_a = dip angle for plane a
ψ_b = dip angle for plane b
ψ_5= dip angle for wedge intersection
γ = unit weight of rock
γ_w = unit weight of water

X, Y, A, B is factor which depend upon the geometry of wedge

$$X = \frac{Sin\theta_{24}}{Sin\theta_{45}Cos\theta_{2.na}} \quad Y = \frac{Sin\theta_{13}}{Sin\theta_{35}Cos\theta_{1.nb}} \quad A = \frac{Cos\psi_a - Cos\psi_b Cos\theta_{na.nb}}{Sin\psi_5.Sin^2\theta_{na.nb}}$$

$$B = \frac{Cos\psi_b - Cos\psi_a Cos\theta_{na.nb}}{Sin\psi_5.Sin^2\theta_{na.nb}}$$

Figure Q1(c): Wedge failure mode formula

FINAL EXAMINATION

SEMESTER/SESSION : SEM II 2021/2022
PROGRAMME CODE : BFF
COURSE NAME : GEOLOGY ENGINEERING
COURSE CODE : BFC 21303

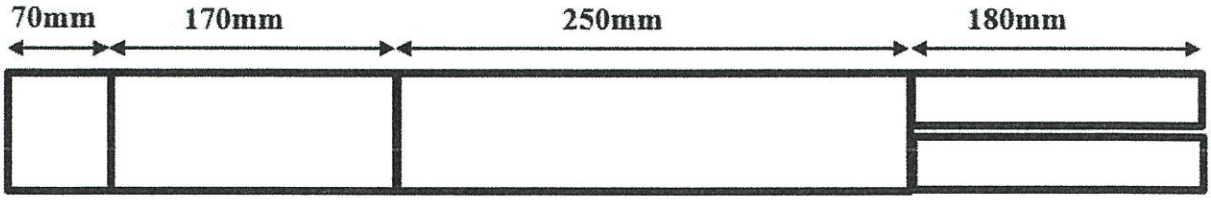


Figure Q4(a): Illustration of cylindrical core sample at 54mm diameter for BH1