Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	ENGINEERING GEOLOGY
COURSE CODE	:	BFC21303
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **ALL** QUESTIONS 2. WRITE DOWN YOUR ANSWERS IN THE ANSWER BOOKLET 3. ATTACH ALL RELATED ANSWERS IN THE ANSWER BOOKLET

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

Q1 (a) Describe about geology in science study.

(4 marks)

(b) Explain about mineral in geological study.

(4 marks)

(c) Explain and illustrate the classification of igneous rocks based on the textures below:

(i) Aphanetic texture
(ii) Porphyritic texture
(iii) Pheneritic texure

(9 marks)

(d) Sedimentary rocks are the second major rock group. It is formed from fine constituents of rock usually from mountainous areas which are formed by diagnesis process.

(i) Illustrate the whole process of sedimentary rock formation known as diagnesis.

(4 marks)

(ii) Discuss the potential danger of limestone as a building foundation and dam structure.

(4 marks)

Q2 (a) Describe and illustrate the metamorphic foliations as given below:

(i) Slaty
(ii) Phylitic
(iii) Schitose
(iv) Gneissic

(8 marks)

(b) Describe the percentage quantity of rock for all subsurface weathering profiling (Zone 1, 2, 3, 4, 5 and 6).

(6 marks)

(c) Discuss the application of zone and weathering grade description of rocks in civil engineering.

(5 marks)

(d) Describe and illustrate all types of fold.

(6 marks)

Q3 (a) Discuss and illustrate the suitable method of geophysics to determine the groundwater.
(6 marks)

(b) In order to analyze the quality of rock mass for construction purposes in Batu Pahat, two types of rock core were extracted from two boreholes at the Batu Pahat site which are denoted as sample A and sample B, as shown in **Figure Q3(a)**.

(i) Determine the Solid Core Recovery (SCR %) of the sample A and B.
(ii) Compute the Rock Quality Designation (RQD) for both of the samples.
(iii) Based on the answer from **Q3(b)(ii)** and **Table 1**, justify the best quality of rock mass should be preferred for bounding foundation structure.
(6 marks)

(c) Discuss the differences between point load test and uniaxial compressive test
(4 marks)

(d) Shale is a sedimentary rock that naturally possesses lamination texture which gives some problems in foundation structure for building construction.

(i) Based on **Figure Q3(b)**, draw an expected graph and discuss the effect of lamination direction of shale to its strength when it subjected to a point load test.
(6 marks)

(ii) If 10 irregular lumps of shale rock are tested in a slake durability test, draw the expected shape of the samples before and after the test and discuss the effect of the laminations to the slake durability index of the shale.
(3 marks)

Q4 A road cutting 50 m deep is driven through a sequence of metamorphic rock. The rock slope face cutting in the direction of 360^0 and dip angle 70^0. The geologist has mapped the cutting area and produced an equal area stereonet plot showing the pole plot concentrations presented in **Figure Q4(a)**. **Table 2** shows the data of slope geometry and rock parameters.

(a) Analyse the entire failure mode for both proposed rock slope as well as the criterion as an evidence using **Table Q3** and **Figure Q4(b)**.
(5 marks)

(b) Calculate the factor of safety for wedge failure mode using formula in **Figure Q4(c)** when the tension crack is completely filled with water.
(12 marks)

(c) Calculate the factor of safety for planar failure mode using formula in **Figure Q4(d)** when the tension crack is completely filled with water. Improve the factor of safety of slope to 1.5 due to planar failure via calculate the force and length needed to apply by the anchor system.

(8 marks)

– END OF QUESTIONS –

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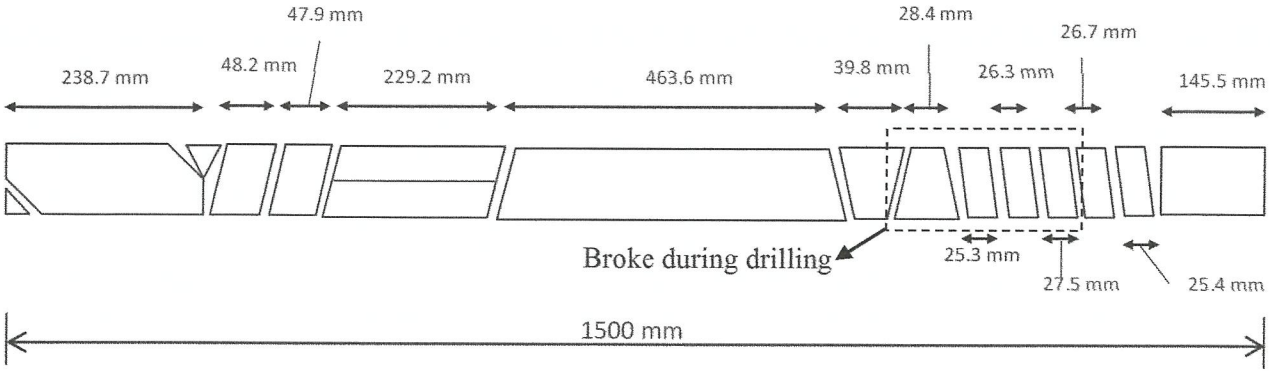
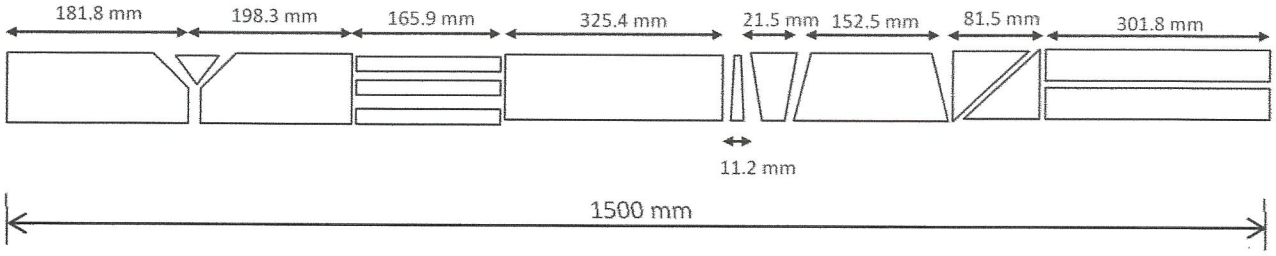


(i)



(ii)

FIGUREQ3(a) Rock core samples extracted in Batu Pahat, Johor; (i) Sample A, and (ii) Sample B

TABLE 1: Rock quality designation (RQD) description (Deere, 1989)

RQD (%)	Description of RQD
0-25	Very Poor
25-50	Poor
50-75	Moderate
75-90	Good
90-100	Very Good

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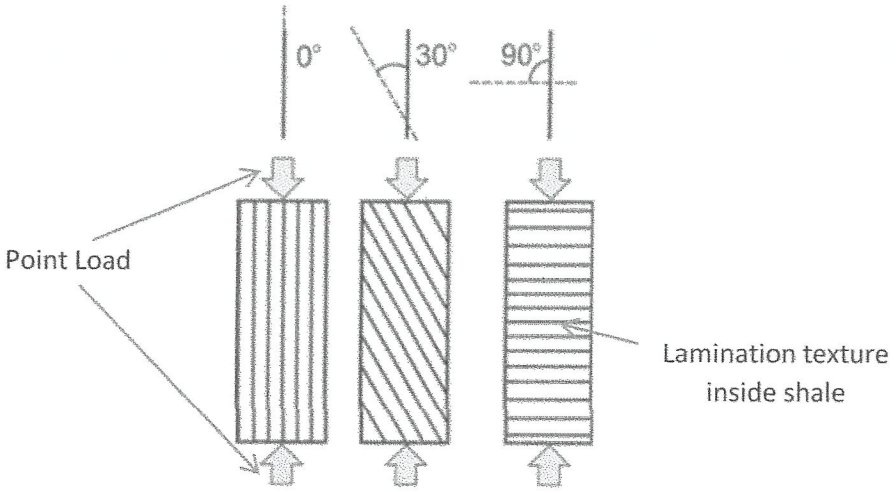

FIGURE Q3(b): Shale with three different lamination orientations subjected to point load test

TABLE 2: Parameter of rock slope

Parameters	Values
Rock unit weight, γ_r	25 kN
Rock friction angle, $\emptyset = \emptyset_a = \emptyset_b$	30°
Water unit weight, γ_w	9.81°
Cohesion of discontinuities, $C_a = C_b$	100 kPA
Height of slope / Height of wedge /Height of plane, H	100 m
Tension crack depth, Z = Tension crack height, Z_w	3 m
Upper slope data	10° (dip direction) and 0° (dip angle)
Inclined angle of anchor (Ω) = (ψT)	20°
Bars for Y25 = 10 ton	100 kN

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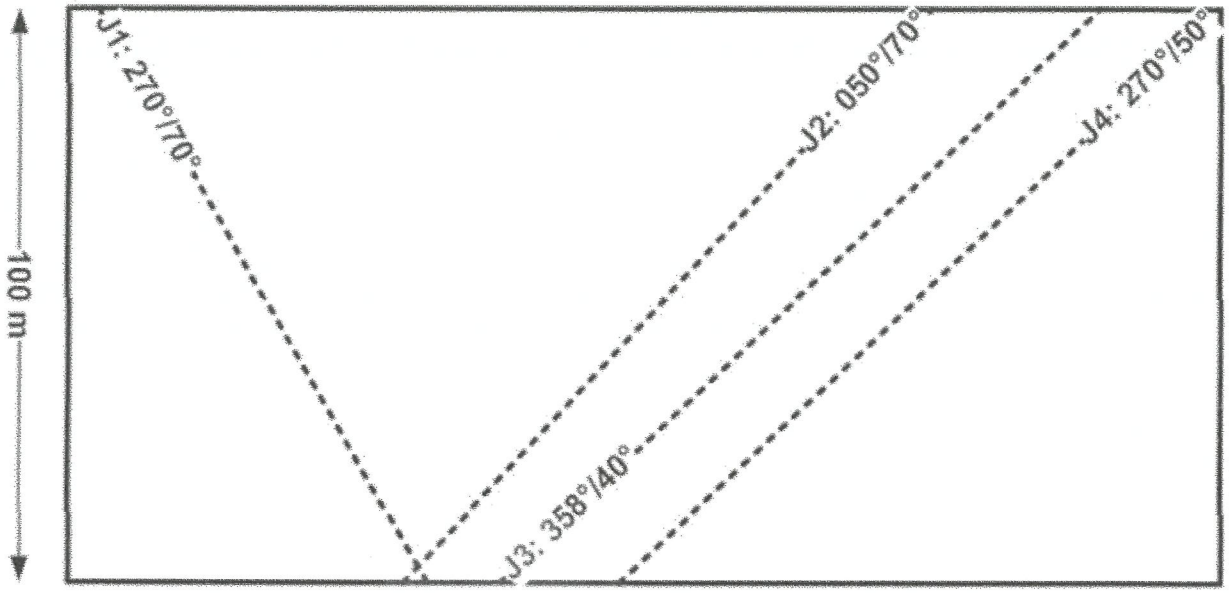

FIGURE Q4(a): Rock slope scanline mapping

TABLE Q3: Criterion for the mode of rock slope failure

Modes of failure	Criteria are met
Circular	i. Very weak material, highly jointed or fractured or weak soil ii. Homogenous soil
Planar	i. Dip direction lie 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 > intersection of 2 plane angle > friction angle) ii. driving force due to the weight of wedge must exceed the frictional resistance of the planes.
Toppling	i. The dip direction must lie between ±10° of opposite slope dip direction. ii. $(90^0 - \psi_f) + \phi \leq \psi_t$

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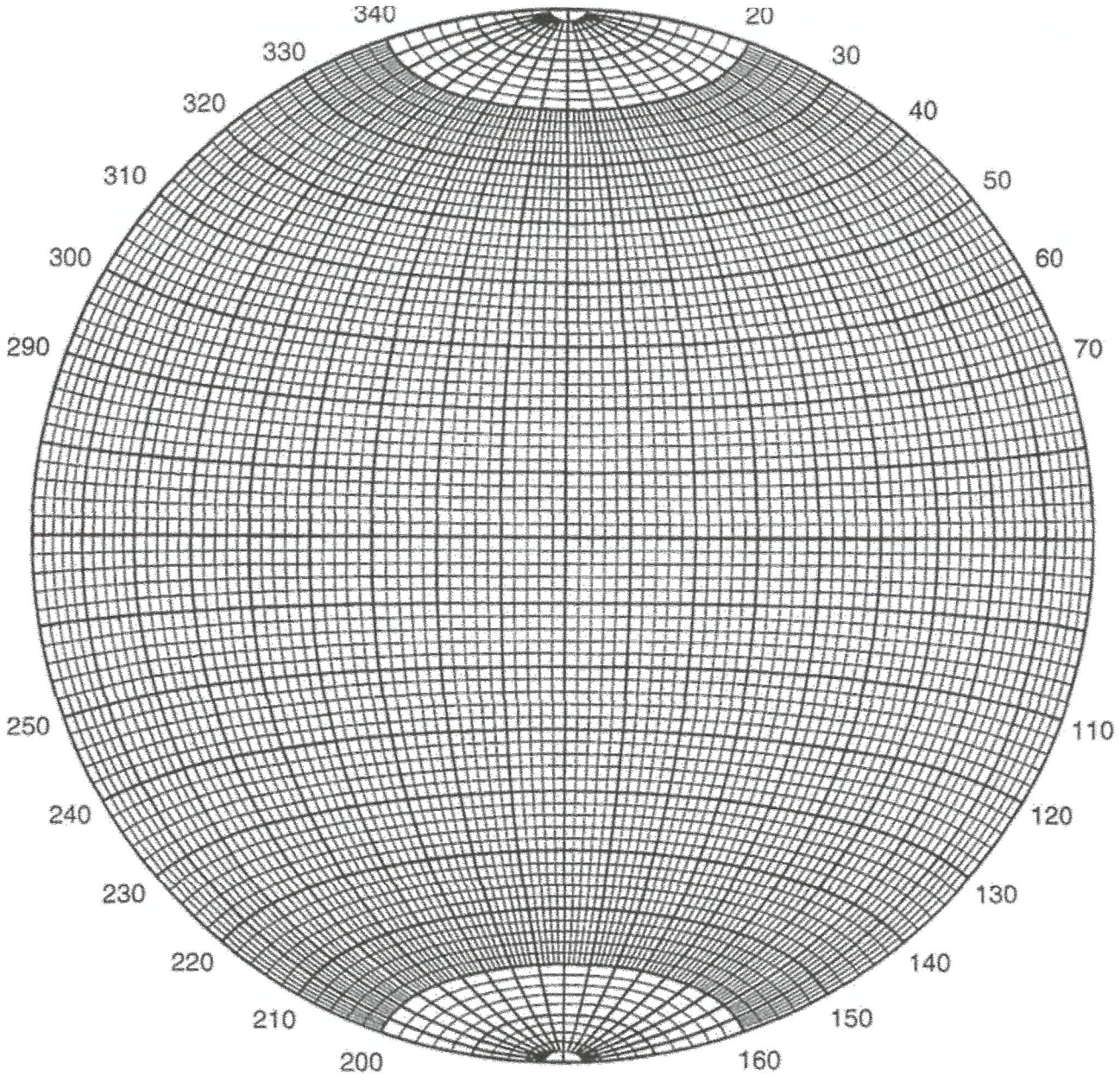

FIGURE Q4(b): Equatorial equal-area stereo-net marked in 2° intervals

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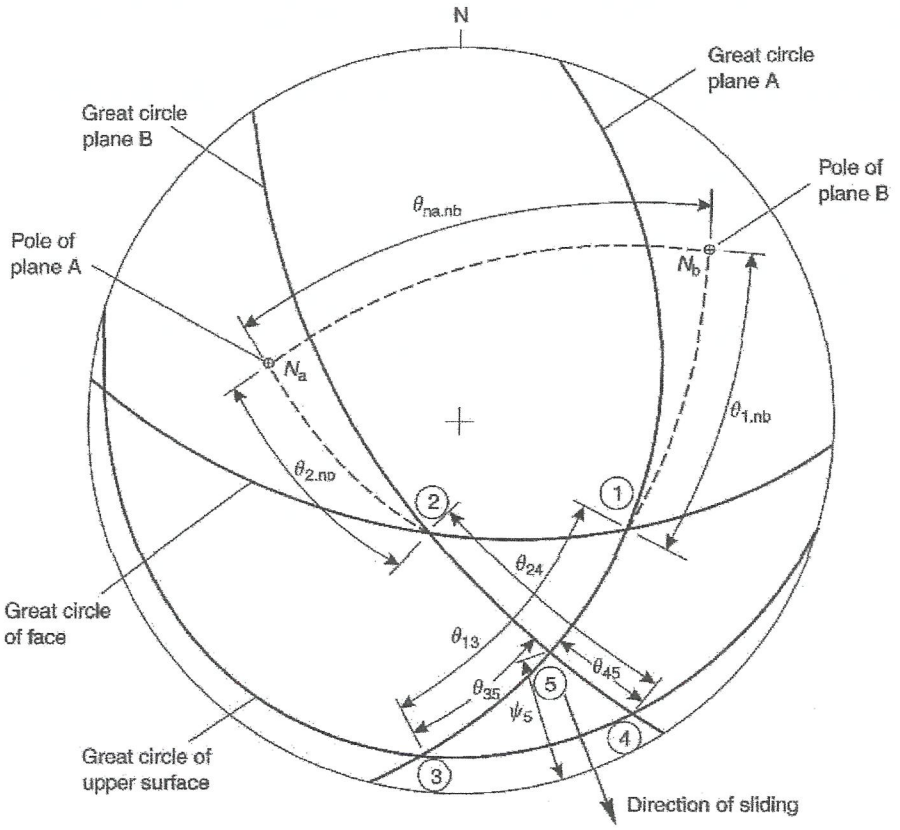

Given:

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

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 Q4(c): Rock slope formula (Wedge failure)

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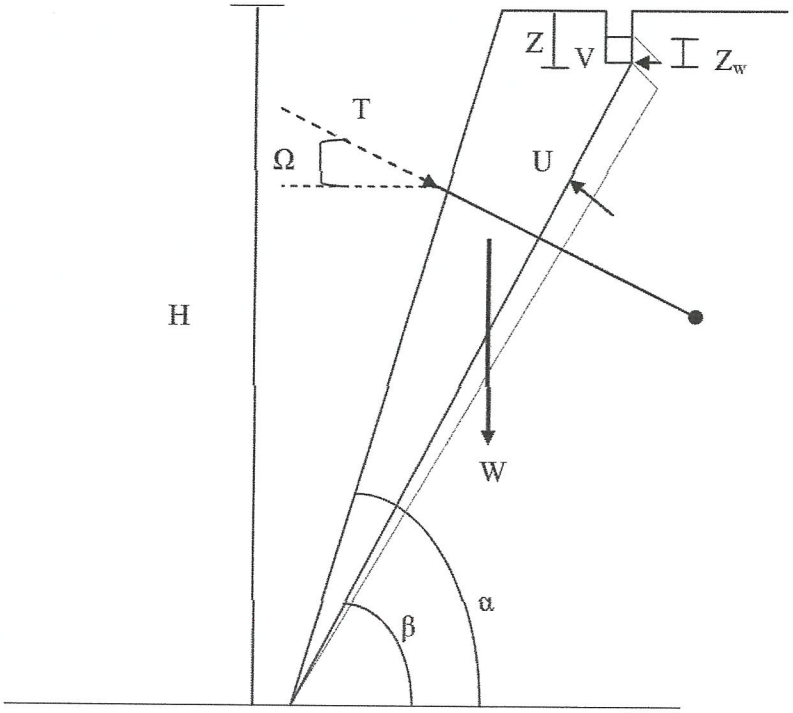

Given:

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

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).cosec β

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

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

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

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

FIGURE Q4(d): Rock slope formula (Planar failure)