Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	ENGINEERING GEOLOGY
COURSE CODE	:	BFC 21303
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015 / JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Explain the term geology and engineering geology.

(5 marks)

(b) Explain the plate boundary type with particular reference to convergent boundaries.

(4 marks)

(c) Illustrate and explain the physical properties of colour and luster in mineral.

(6 marks)

(d) Illustrate and explain the igneous rock textures with particular reference to:

(i) Phaneritic texture
(ii) Aphanetic texture
(iii) Glassy texture
(iv) Porphyritic texture
(v) Vesicular Texture

(10 marks)

Q2 (a) Igneous rocks vary greatly in its suitability for various types of engineering projects. Discuss the relationship of unaltered intrusive igneous rock and extrusive igneous rock in engineering works.

(6 marks)

(b) Describe the classification of sedimentary rock with particular reference to:

(i) Detrital or clastic sedimentary rock

(3 marks)

(ii) Chemical sedimentary rocks

(3 marks)

(c) Define the term for metamorphic texture with particular reference to:

(i) Foliation
(ii) Lineation
(iii) Non-foliated or granular

(3 marks)

(d) Explain **FOUR (4)** factors that control the rate of weathering.

(4 marks)

(e) Erosion is one of the important agents of removal and transportation of surface earth.

(i) Describe **THREE (3)** factors that affect the rate of erosion by water/stream.

(3 marks)

(ii) Explain the transportation of sediment by wind.

(3 marks)

Q3 (a) The earth crust that responds to certain confined stresses will deform itself and resulted in various geological structures.

(i) Sketch and explain the terminology of joint, fold and fault.

(3 marks)

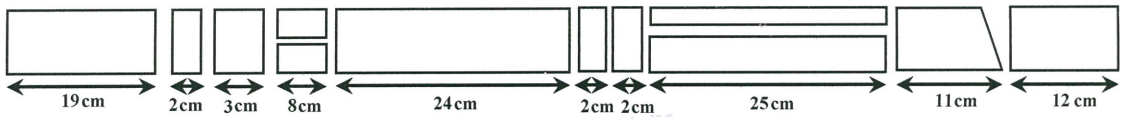
(ii) Classify and sketch all categories of fold.

(4 marks)

(b) Discuss the resistivity method related to its concepts, applications, advantages and disadvantages.

(6 marks)

(c) 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 rock sample below.



(6 marks)

(d) Distinguish between index test and strength test in rock testing.

(6 marks)

Q4 (a) Explain the discontinuity mapping using the scan line and the random methods.

(2 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°. The analysis of slope failure indicates that joint set 3 is potential to fail with the planar failure mode and intersection of joint set 1 and 2 causes wedge failure.

(i) Calculate the factor of safety for wedge failure mode for intersection of joint set 1 and 2 using the formula in **FIGURE Q4(b)(i)** when the tension crack is completely filled with water.

(8 marks)

(ii) Calculate the factor of safety for planar failure mode using the formula in **FIGURE Q4(b)(ii)** when the tension crack is completely filled with water.

(4 marks)

(iii) Calculate the tensional anchor force that is required to increase the factor of safety to 1.5 using similar condition in question **Q4(b)(ii).**

(3 marks)

(iv) By maintaining the slope angle, investigate a suitable new rock slope dip direction in order to avoid any potential of rock slope failure mode using the equatorial equal-area stereo-net in **FIGURE Q4(b)(iv)**.

(8 marks)

TABLE 1

Slope dip direction	= 360°
Slope face angle	=70°
Height of rock slope	= 100 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°

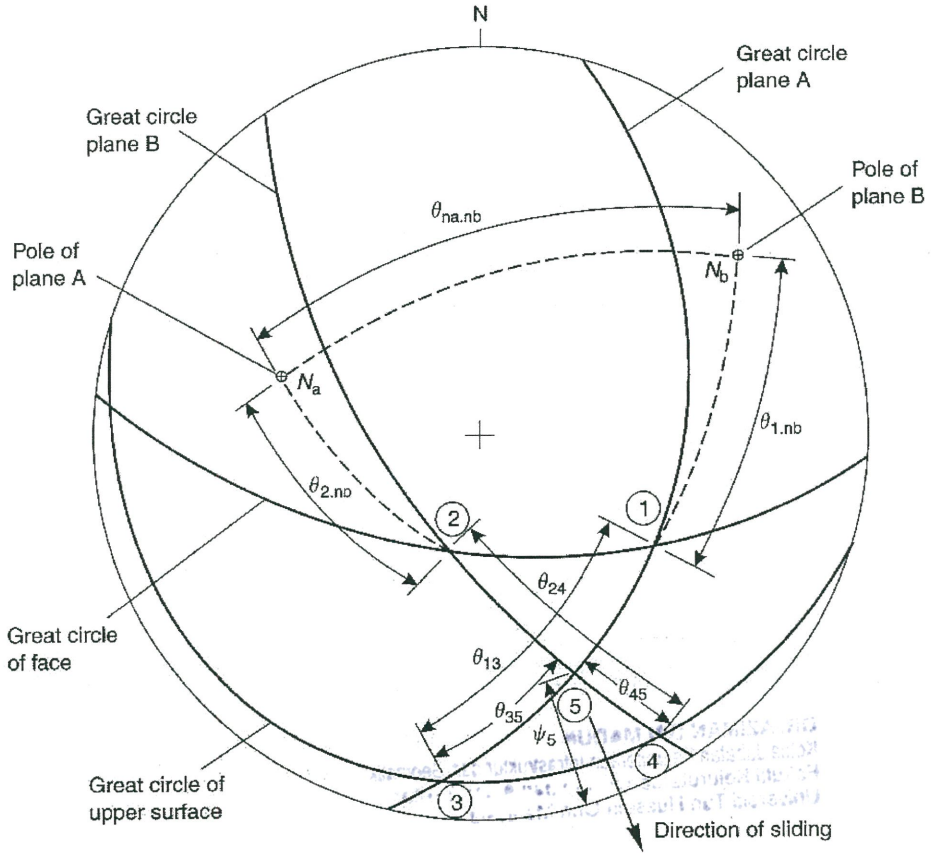
TABLE 2

Joint set 1	Joint set 2	Joint set 3
30°/68°	330°/64°	006°/60°

-END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER / SESSION : I/ 2015/2016 PROGRAMME : BFF
COURSE : ENGINEERING GEOLOGY 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 Q4(b)(i)

FINAL EXAMINATION

SEMESTER / SESSION : I/ 2015/2016 PROGRAMME : BFF
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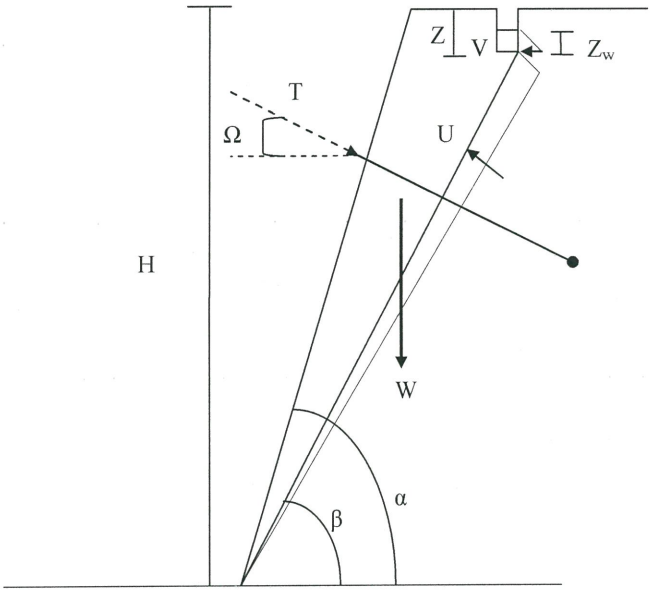

Given:

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

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

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

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

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

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

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

FIGURE Q4(b)(ii)

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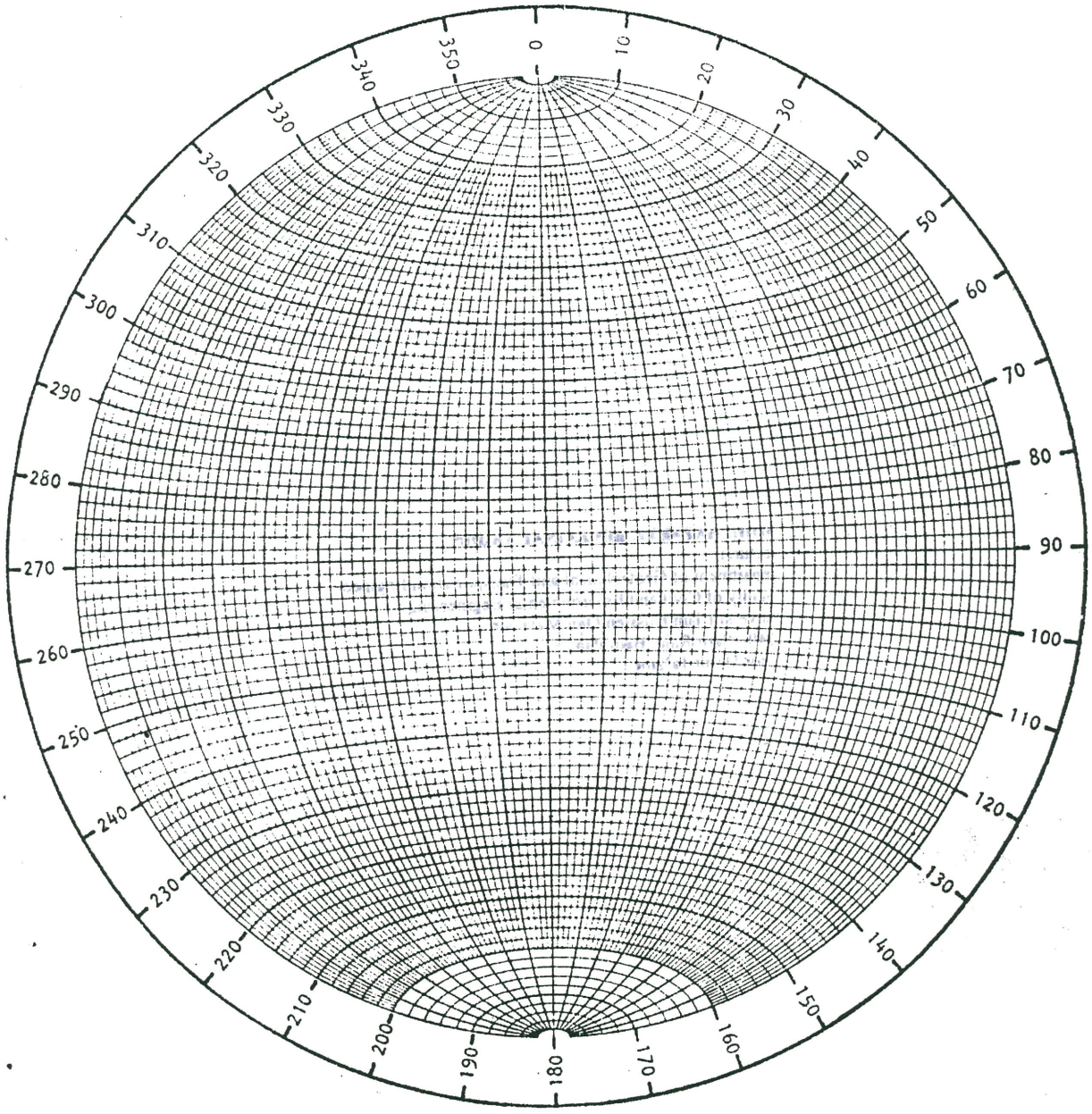

FIGURE Q4(b)(iv): Equatorial equal-area stereo-net marked in 2° intervals