UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION (ONLINE) SEMESTER II SESSION 2019/2020

COURSE NAME	:	ADVANCED GEOTECHNIC
COURSE CODE	:	BFG 40203
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2020
DURATION	:	6 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) By using appropriate illustration and explanations, relate the geotechnical parameters as listed below:

(i) Isotropic and anisotropic soil condition.
(3 marks)

(ii) Normal stress and shear stress in soil.
(3 marks)

(iii) Linearly elastic material and non-linearly elastic material.
(3 marks)

(iv) Deformation of soil cylinder due to loading and unloading conditions.
(3 marks)

(v) Tangent elastic modulus and secant elastic modulus.
(3 marks)

(b) There will be a latest development of mix commercial area at Parit Raja The fill of the embankment will be placed on a soft soil. The developer is very concern about the stability of embankment immediately after construction.

As a geotechnical engineer, you are required to propose the most practical method, whether consolidated undrained (CU), unconsolidated undrained (UU) or consolidated undrained (CU) in obtaining the parameters of shear strength of soft soil in triaxial test. Justify your answer.
(10 marks)

Q2 (a) (i) Based on the actual situation, soil may either be in saturated or unsaturated condition. Briefly compare the difference in respect to the strength properties.
(4 marks)

(ii) If the Universiti Tun Hussein Onn Malaysia (UTHM) at Parit Raja is your construction site. Distinguish **TWO (2)** possible geotechnical problems triggered by unsaturated soil condition.
(4 marks)

(b) Settlement of foundation may occur due to changes of water content in unsaturated soil. Briefly discuss with suitable sketch;

(i) the settlement of foundation during wetting.
(5 marks)

(ii) the settlement of foundation during drying.
(5 marks)

(c) Correlate the strength of unsaturated soil in relation to the net stress (σ-ua) and the matrix suction (u_a-u_w).

(7 marks)

Q3 (a) A direct shear test is a soil test to determine the shear strength of a soil. For dense sand samples, the direct shear test will result to a certain parameter named dilatancy. Explain what dilatancy is and derive its equation in relation to Coulomb's theoretical equation.

(10 marks)

(b) A triaxial test was used to determine the stress path of a normally consolidated clay soil. The first set of stresses is where $\sigma_1' = \sigma_3' = \sigma_3 = 50$ kN. The deviator stress ($\Delta\sigma_d$) is then increase to 55 kN with pore pressure (u) of 25 kN. A third reading again shows the deviator stress ($\Delta\sigma_d$) then increase to 80 kN with pore pressure (u) of 20 kN. Based on the results given,

(i) Plot the stress paths in a p versus q graph and draw the critical state line

(10 marks)

(ii) Determine the angle (α) of the critical state line.

(5 marks)

Q4 (a) State **FOUR (4)** parameters that is used in geotechnical engineering subjected to the scaling law.

(4 marks)

(b) Critically discuss the difficulties of adopting physical models in geotechnical engineering. Your answer must take into consideration of the dimensional analysis and scaling law.

(9 marks)

(c) Using a centrifuge test, the energy of an explosion for rock blasting needs to be simulated. The definition of energy (E) is the product of the multiplication of force (F) with the distance (d). Using the formula of scaling law, let an explosion from a given device is up to 1 TJ of energy. If we model this explosion in a 100g centrifuge test, what is energy of explosion required in the test.

(7 marks)

(d) Briefly discuss what is numerical modelling and how it can be applied in geotechnical engineering applications.

(5 marks)

-END OF QUESTIONS-

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TABLE Q3(b): Result for consolidation test

P' (kN/m^2)	25	50	200	400	800	1600	800	400	200
e	1.65	1.64	1.62	1.57	1.51	1.44	1.45	1.46	1.47

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LIST OF FORMULA

STRESS STRAIN PARAMETERS

$$q' = \sigma'_1 - \sigma'_3$$

$$p' = \frac{1}{3}(\sigma'_1 - \sigma'_3)$$

$$\varepsilon_s = \frac{2}{3}(\varepsilon_1 - \varepsilon_3)$$

$$\varepsilon_v = \varepsilon_1 + 2\varepsilon_3$$

$$K' = \frac{\delta p'}{\delta \varepsilon_v}$$

$$3G' = \frac{\delta q'}{\delta \varepsilon_s}$$

$$E' = \frac{\delta'\sigma'_1}{\delta \varepsilon_1}$$

$$\upsilon' = -\frac{\delta'\varepsilon_3}{\delta \varepsilon_1}$$

$$\upsilon' = \frac{3K' - 2G}{2G + 6K'}$$

$$G' = \frac{E'}{2(1+\upsilon')}$$

$$K' = \frac{E'}{3(1-2\upsilon')}$$

UNSATURATED SOIL

$$(u_a - u_w) = \frac{4T}{(\nu - 1)d_s}$$

$$d_v = (\upsilon - 1)d_s$$

$$T\pi d_v = (u_a - u_w)\frac{\pi d_v^{\,2}}{4}$$

$$\tau' = c' + (\sigma_n - u_a)\tan\phi' + (u_a - u_w)\tan\phi'^{b}$$

CRITICAL STATE

$$e_f = e_\Gamma - \lambda \ln p'_f$$

$$\lambda = \frac{C_c}{2.3}$$

$$\kappa = \frac{C_r}{2.3}$$

$$q = \pm Mp'\sqrt{\left(\frac{p'_c}{p'} - 1\right)}$$

$$q_f = Mp'_f$$

$$M_c = \frac{6\sin\phi'_{cs}}{3 - \sin\phi'_{cs}}$$

$$M_e = \frac{6\sin\phi'_{cs}}{3 + \sin\phi'_{cs}}$$

$$q_f = M\exp\left(\frac{e_\Gamma - e_o}{\lambda}\right)$$

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$$\lambda = \frac{|\Delta e|}{\ln(p'_c/p'_1)}$$

$$\kappa = \frac{|\Delta e|}{\ln(p'_c/p'_0)}$$

$$e_\Gamma = e_0 + (\lambda - \kappa) ln \frac{p'_c}{2} + \kappa \; ln \, p'_o$$