UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	:	ADVANCED GEOTECHNIC
COURSE CODE	:	BFG 4023
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	DECEMBER 2012/JANUARY 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) Explain with the aid of sketches the difference between stress-strain behaviour of work hardening and work softening theories.

(5 marks)

(b) The following results were obtained from CU tests on a clay soil that is the foundation material for an embankment:

Table 1: Consolidated undrained (CU) test results

σ_3 (kN/m^2)	$\sigma_1 - \sigma_3$ (kN/m^2)	Δu (kN/m^2)
300	331	111
400	420	160
600	487	322

Recommend the shear strength parameters to be used for short-term and long-term analyses. The maximum confining pressure at the depth of interest is 300 kN/m^2.

(20 marks)

Q2 (a) The construction and operation of a dam involve unsaturated and saturated soil behaviour. By using appropriate sketches explain the changes of pore air pressure and pore water pressure

(i) during the early stage of construction

(5 marks)

(ii) once the construction of the dam is complete and filling of the reservoir

(5 marks)

(b) The void ratio of a soil is 1.2. Determine the bulk and effective unit weights for the following degrees of saturation:

(i) 75 %
(ii) 95 %
(iii) 100 %

(12 marks)

(c) Based on **Q2(b)** what is the percentage of error in the bulk unit weight if the soil is 75 % saturated but assumed to be 100 % saturated.

(3 marks)

Q3 (a) Geotechnical engineering design necessitates the consideration of the drainage conditions (drained or undrained) from the stressed soil in order to simulate the long or short term stability respectively. Show that, in an undrained triaxial compression test, the pore water pressure at failure in a saturated soil is

$$u_f = p_0 - \left(1 - \frac{M}{3}\right)\exp\left(\frac{\Gamma - v}{\lambda}\right)$$

where p_0 is the value of the initial consolidating pressure.

(10 marks)

(b) Three specimens were cut from a single sample of saturated normally consolidated clay. These were subjected to drained triaxial compression tests with the following results:

Table 2: Triaxial compression test results

Test No.	1	2	3
Cell pressure, σ_3 (kN/m^2)	200	300	400
Axial stress at failure, σ_1 (kN/m^2)	337	573	810
Pore water pressure, u (kN/m^2)	100	100	100
Final water content (%)	40.5	36.3	?

(i) By indicating your assumptions, determine the values of M, Γ, λ, c′ and ϕ' for this soil. (Specific gravity of the soil particles is 2.70).

(8 marks)

(ii) Estimate the value of the water content at the end of the third test

(3 marks)

(iii) Estimate the pore water pressure in this soil at the end of another undrained test with a cell pressure of 200 kN/m^2 (no back pressure), and water content of 40.5%.

(4 marks)

Q4 (a) It is common practice to analyse an engineering problem through mathematical, physical and conceptual models. Critically discuss the difficulties of adopting physical models in geotechnical engineering. Your answer must consists with the comments on the spring water analogy and the centrifuge testing.

(13 marks)

(b) Write the governing equations of the Mohr Coulomb and Cam Clay models used in geotechnical softwares. Discuss the differences and compare the advantages of these models.

(12 marks)

Q5 (a) Advancements in geotechnical engineering have been catalysed by the contemporary rapid developments in Information Technology.

(i) Explain with the aid of sketches, where appropriate, how developments in computer hardware has facilitated the laboratory testing in soil mechanics and field testing / monitoring in geotechnical engineering.

(9 marks)

(ii) Describe and compare **THREE (3)** of the software packages commonly used in geotechnical engineering.

(7 marks)

(b) Discuss the benefits and any dangers of the influence of the advancement of computer hardware and software on the developments in geotechnical engineering.

(9 marks)

-END OF QUESTION-

S1 (a) Jelaskan dengan bantuan lakaran perbezaan kelakuan tegasan-terikan diantara teori pengerasan kerja dan pelembutan kerja.

(5 markah)

(b) Keputusan berikut diperoleh dari ujian terkukuh tak tersalir (CU) terhadap tanah liat yang dijadikan bahan asas tambakan:

Jadual 1: Keputusan ujian Terkukuh Tak Tersalir (CU)

σ_3 (kN/m^2)	$\sigma_1 - \sigma_3$ (kN/m^2)	Δu (kN/m^2)
300	331	111
400	420	160
600	487	322

Cadangkan parameter-parameter kekuatan ricih untuk analisis jangka pendek dan jangka panjang. Tekanan keliling maksimum pada kedalaman yang dikehendaki adalah 300 kN/m^2.

(20 markah)

S2 (a) Pembinaan dan operasi empangan melibatkan kelakuan tanah separa tepu dan tepu. Dengan menggunakan lakaran yang sesuai, jelaskan secara terperinci perubahan tekanan liang udara dan tekanan liang air

(i) semasa diawal pembinaan

(5 markah)

(ii) sebaik sahaja pembinaan siap dan takungan diisikan air.

(5 markah)

(b) Nisbah lompang tanah adalah 1.2. Tentukan berat unit gembur dan berat unit berkesan bagi darjah ketepuan berikut:

(i) 75 %
(ii) 95 %
(iii) 100 %

(12 markah)

(c) Berdasarkan soalan **S2(b)**, berapakah peratus ralat nilai berat unit gembur jika tanah tersebut mempunyai ketepuan 75 % tetapi telah dianggap tepu 100 %.

(3 markah)

S3 (a) Rekabentuk kejuruteraan geoteknik memerlukan pertimbangan keadaan saliran (tersalir atau tak tersalir) dari tanah yang dibebankan bagi mensilumasikan kestabilan jangka pendek dan jangka panjang. Tunjukkan bahawa bagi ujian mampatan tiga paksi tak tersalir, tekanan air liang semasa gagal bagi tanah tepu adalah

$$u_f = p_0 - \left(1 - \frac{M}{3}\right)\exp\left(\frac{\Gamma - v}{\lambda}\right)$$

di mana p_o ialah nilai tekanan pengukuhan awal

(10 markah)

(b) Tiga spesimen dipotong dari satu sampel tanah liat tepu terkukuh normal. Ia telah dikenakan ujian mampatan tiga paksi dengan keputusan seperti berikut:

Jadual 2: Keputusan ujian mampatan tiga paksi

Test No.	1	2	3
Tekanan sel, σ_3 (kN/m^2)	200	300	400
Tegasan paksi ketika gagal, σ_1 (kN/m^2)	337	573	810
Tekanan air liang, u (kN/m^2)	100	100	100
Kandungan lembapan akhir (%)	40.5	36.3	?

(i) Dengan menunjukkan andaian anda, tentukan nilai M, Γ, λ, c′ dan ϕ' bagi tanah ini. (Graviti tentu tanah adalah 2.70).

(8 markah)

(ii) Anggarkan nilai kandungan air diakhir ujian ketiga

(3 markah)

(iii) Anggarkan tekanan air liang di dalam tanah ini diakhir ujian tak tersalir yang lain dengan tekanan sel sebanyak 200 kN/m^2 (tiada tekanan belakang), dan kandungan lembapan adalah 40.5%.

(4 markah)

S4 (a) Adalah menjadi amalan biasa untuk menganalisis masalah kejuruteraan melalui model matematik, fizikal dan model yang berkonsep. Bincangkan secara kritis kesukaran penggunaan model fizikal dalam kejuruteraan geoteknik. Jawapan anda mestilah mengandungi komen terhadap analogi spring air dan ujian emparan.

(13 markah)

(b) Tulis persamaan model "*Mohr Coulomb*" dan "*Cam Clay*" yang digunakan dalam perisian geoteknik. Bincangkan perbezaan dan bandingkan kelebihan model-model ini.

(12 markah)

S5 (a) Kemajuan dalam kejuruteraan geoteknik telah dipacu oleh perkembangan semasa yang pesat dalam teknologi maklumat.

(i) Terangkan dengan bantuan lakaran jika perlu, bagaimana perkembangan dalam perkakasan komputer telah memudahkan ujikaji makmal dalam mekanik tanah dan ujian lapangan dalam kejuruteraan geoteknik.

(9 markah)

(ii) Terangkan dan bandingkan **TIGA (3)** pakej perisian yang biasa digunakan dalam kejuruteraan geoteknik.

(7 markah)

(b) Bincangkan faedah dan bahaya kesan kemajuan perkakasan dan perisian komputer terhadap perkembangan dalam kejuruteraan geoteknik.

(9 markah)

-SOALAN TAMAT-