Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	GEO-ENVIRONMENT
COURSE CODE	:	BFG 40303
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015 / JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ANY **TWO (2)** QUESTIONS FROM PART A AND ANY **TWO (2)** QUESTIONS FROM PART B

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

PART A CHOOSE AND ANSWER TWO QUESTIONS ONLY FROM PART A

Q1 (a) Water present in pore spaces of soil is termed as soil water or pore water. The quantity of water present in the pores will significantly influence its physical, chemical and engineering properties.

Briefly explain these **TWO (2)** categories of water that exist in the soil.

(6 marks)

(b) Cation exchange capacity (CEC) is defined as the sum of exchangeable cations soil can adsorb per 100 g of dry soil.

(i) List down any **FIVE (5)** of the factors that may influence the CEC of soil.

(5 marks)

(ii) Explain how any **THREE (3)** of the factors listed above affect the CEC of soil.

(6 marks)

(c) The contaminants that can pose serious threat to humans persist in short or long interval of time. The major role of a geoenvironmental engineer is to predict the fate of contaminants in the subsurface and minimize its migration towards groundwater.

Evaluate the effectiveness of using kaolinite soil as compared to illite soil in retention and transport of contaminants.

(8 marks)

Q2 (a) (i) Define what is considered as underground storage tank?

(2 marks)

(ii) Evaluate the potential risk of having a fish pond adjacent to the petrol station.

(6 marks)

(b) (i) Briefly explain what is referred as drainfield in designing of septic system?

(2 marks)

(ii) Evaluate the suitability use of conventional septic system in urban areas with high intensity of population.

(6 marks)

(c) Unintentional spills of engine oil was found at site A. As the consultant, you are required to:

(i) Propose suitable methods in mitigating the problem.

(4 marks)

(ii) Evaluate the potential effect of spills of engine oil on the physico-chemical properties of soils.

(5 marks)

Q3 (a) (i) Briefly explain the main objective to carry out site investigation works for developing land which may be contaminated.

(3 marks)

(ii) Why the "Desk study" should be carried out before the "sampling and analysis" is carried out?

(2 marks)

(b) Propose a site investigation scheme if a water retention pond is proposed to be constructed on the area that previously was petrol station.

(10 marks)

(c) Risk assessment investigation is required for developing areas which may be contaminated.

Briefly explain what are referred as Tier 1, Tier 2 and Tier 3of risk assessment investigation.

(10 marks)

PART B CHOOSE AND ANSWER ONLY TWO QUESTIONS FROM PART B

Q4 (a) Explain in detail the term 'sorption'. State why sorption is similar to partitioning.

(5 marks)

(b) List and explain in detail three most common sorption models involving solid and liquid phases. Show the derivation of the models.

(10 marks)

(c) When it became known that a new process planned for a chemical plant was expected to produce a highly toxic waste, a plant environmental engineer wrote to the city newspaper expressing opposition to the action.

In your opinion, would the engineer's action be legal and/or ethical?

Discuss this by referring to (i) ethics and (ii) whistle blowing aspects.

(10 marks)

Q5 (a) Differentiate between in situ and ex-situ remediation technology and explain why in situ remediation approach is preferable as oppose to an ex-situ remediation approach

(5 marks)

(b) A soil is contaminated with 300 mg/kg of perchloroethylene, PCE. PCE is a colorless liquid commonly used in the dry cleaning of fabrics industries. Soil washing is proposed with a solids concentration of 0.1 kg/L. Calculate the soil washing removal efficiency if

(i) water is used as the washing solution (with K_d = 100 L/kg), and

(ii) a solvent is used as the washing solution (with K_d= 10L/kg)

(10 marks)

(c) A former unlined solid waste disposal site that accepted municipal and industrial waste is located 150 meters from a drinking water well in a rural town in Kelantan. Investigation indicates the presence of organic and inorganic compounds such as benzene and lead in groundwater immediately downgrade of the landfill and the groundwater plume is found to migrate in the direction of the drinking water well in the town.

A potential remedial strategy considered in this situation includes (1) capping the solid waste disposal site, (2) installing a leachate collection system, (3) constructing an impermeable slurry wall, (4) installing a groundwater extraction well system, (5) air stripping of extracted leachate and groundwater, and (6) discharge of treated leachate and groundwater to nearby streams.

Identify various geo-environmental engineering issues and/or tasks involved in this project. Explain them briefly.

(10 marks)

Q6 (a) State the **THREE (3)** physical processes which affect the flow of solute (contaminants) in groundwater.

(4 marks)

(b) Define molecular diffusion, advective diffusion and turbulent diffusion. Differentitiate between molecular diffusion, advective diffusion and turbulent diffusion.

(10 marks)

(c) For a contaminant flow in soils/aquifers, use the Ogata & Banks solution, shown below, to determine the breakthrough curves if the dispersion is $4cm^2/h$, x = 20 cm and the mean velocity is 4 cm/h.

Determine the curve for a time of 2hr. Use the **Table Q6** for the complementary error function values. Comment briefly on your solution.

$$\frac{c(x,t)}{c_o} = \frac{1}{2}\left\{ erfc\left(\frac{x - v_s t}{2\sqrt{D_{hd} t}}\right) + \exp\left(\frac{v_s x}{D_{hd}}\right) * erfc\left(\frac{x + v_s t}{2\sqrt{D_{hd} t}}\right)\right\}$$

where $c\ (x,t)$ = the concentration at any distance x > 0
C_o = the initial contaminant concentration, g/m^3
v_s = average velocity, m/s
D_{hd} = dispersion coefficient
erfc = complementary error function
exp = exponent

(10 marks)

- **END OF QUESTIONS –**

FINAL EXAMINATION

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COURSE : GEO-ENVIRONMENT COURSE CODE : BFG40303

Table Q6: Error function & Complementary error function table

x	erf(x)	erfc(x)		x	erf(x)	erfc(x)
0.00	0	1		1.3	0.9340079	0.0659921
0.05	0.056372	0.943628		1.4	0.9522851	0.0477149
0.10	0.1124629	0.8875371		1.5	0.9661051	0.0338949
0.15	0.167996	0.832004		1.6	0.9763484	0.0236516
0.20	0.2227026	0.7772974		1.7	0.9837905	0.0162095
0.25	0.2763264	0.7236736		1.8	0.9890905	0.0109095
0.30	0.3286268	0.6713732		1.9	0.9927904	0.0072096
0.35	0.3793821	0.6206179		2.0	0.9953223	0.0046777
0.40	0.4283924	0.5716076		2.1	0.9970205	0.0029795
0.45	0.4754817	0.5245183		2.2	0.9981372	0.0018628
0.50	0.5204999	0.4795001		2.3	0.9988568	0.0011432
0.55	0.5633234	0.4366766		2.4	0.9993115	0.0006885
0.60	0.6038561	0.3961439		2.5	0.999593	0.000407
0.65	0.6420293	0.3579707		2.6	0.999764	0.000236
0.70	0.6778012	0.3221988		2.7	0.9998657	0.0001343
0.75	0.7111556	0.2888444		2.8	0.999925	0.000075
0.80	0.742101	0.257899		2.9	0.9999589	0.0000411
0.85	0.7706681	0.2293319		3.0	0.9999779	0.0000221
0.90	0.7969082	0.2030918		3.1	0.9999884	0.0000116
0.95	0.8208908	0.1791092		3.2	0.999994	0.000006
1.00	0.8427008	0.1572992		3.3	0.9999969	0.0000031
1.10	0.8802051	0.1197949		3.4	0.9999985	0.0000015
1.20	0.910314	0.089686		3.5	0.9999993	0