UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2011/2012

COURSE NAME	:	GEO-ENVIRONMENT
COURSE CODE	:	BFG 4033
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	JANUARY 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 A former industrial site is to be redeveloped to become a private housing with gardens. The site is roughly rectangular in shape with dimensions of 150 m x 300 m (4.5 hectares). A plan of the site is given in **Figure Q1**.

An investigation is to be carry out to assess the nature and extent of contamination of the soil and groundwater in sufficient detail to design remediation works to be undertaken as part of the site's redevelopment.

(a) List the investigation strategies/phases that would be practical to implement in order to obtain information on surface and subsurface conditions appropriate for the objective of the investigation.

(8 marks)

(b) Previous geotechnical investigation had revealed the following sequence of strata at the site as in **Table 1** below.

Table 1 Sequence of Strata

Depth (m)	Material
0 – 1.5	Fill , including demolition waste
1.5 – 3..0	Alluvial silty sands with varying propotion of gravel and clay in different areas of the site. Groundwater level at depth of 2 – 2.5 m
3.0 – 6.0	Sedimentary till, generally comprising stiff clay but with occational sandy lenses.
6.0 - > 20	Sandstone

Explain the works that you will carry out in the exploratory or detail phase of the investigation to produce information on the identified hazards so that the actual risk can be assessed and the need for remediation determined.

(12 marks)

(c) List **FIVE (5)** potential sources of site contamination that the risk require assessment.

(5 marks)

Q2 Soils consist of air, water and solids. They are important for engineering fit for purpose, whereas, for environmentalist soils are the source of human survival.

(a) Explain the meaning of the following acronyms and the important procedures those related to implementation of these initiatives:

(i) CDM

(ii) LSM

(8 marks)

(b) Based on your geotechnical and environmental understanding of pollutant-soil interactions, explain briefly the problems that might be caused by this situation when an engineer attempts to construct a structure on contaminated site.

(8 marks)

(c) Explain with example the effects of contaminants on the engineering properties of soils particularly the unconfined compression strength, compressibility and hydraulic conductivity for design and construction purposes?

(9 marks)

Q3 (a) Define the following terms:
(i) solidification,
(ii) stabilization,
(iii) fixation, and
(iv) hydration.

(4 marks)

(b) Differentiate between an engineering property and a physical property.

(4 marks)

(c) Describe how portland cement can stabilize metallic wastes.

(4 marks)

(d) Identify similarities and differences between the following tests:

(i) TCLP and EP Tox, and

(ii) Unconfined compression tests and one-dimensional consolidation test.

(4 marks)

(e) The subsurface at the site of a toy manufacturing site consists of a well graded mixture of gravel and sand with 5 percent silt. Contaminants found in the soil include benzene, toluene, xylene and vinyl chloride to depths of 3 m. The water table is at a depth of 4 m.

(i) Select the appropriate stabilization reagents and mixing technique; justify your selection.

(ii) Suggest other remedial alternatives which might be feasible.

(9 marks)

Q4 (a) Explain briefly the Langmuir and the Freundlich isotherms.

(4 marks)

(b) Describe the **FIVE (5)** factors that affect adsorption.

(5 marks)

(c) 100 ml of a solution with a TOC (total organic carbon) concentration of 0.5 percent is placed in each of five containers with activated carbon and shaken for 48 hours. The samples are filtered and the concentration of TOC measured, yielding the following analyses:

Table 2 : Concentration of TOC

Container:	1	2	3	4	5
Carbon, g	10	8	6	4	2
TOC, mg/l	42	53	85	129	267

Determine the Freundlich constants, K and n, and plot the isotherm.

(10 marks)

(d) Explain the concept of biobarriers. How can aerobic and anaerobic conditions be created and maintained in biobarriers?

(6 marks)

Q5 (a) State indirect effect would depth to groundwater likely have on the sorption of organic contaminants.

(6 marks)

(b) State the 1-D advection – diffusion equation which is commonly used to model the movement of a contaminant in the subsurface environment. Use the following symbols: C to represent concentration of non reactive contaminants (g/m^3), D represents hydrodynamic dispersion and u as the average fluid velocity.

(6 marks)

(c) A non reactive contaminant, c is applied to a soil column in a laboratory as a step function C_o. Assuming the following boundary conditions $c\ (x, t)$ applies;

$C\ (x, 0) = 0$ for $x \geq 0$
$C\ (0, t) = C_o$ for $t \geq 0$
$C\ (\infty, t) = 0$ for $t \geq 0$

The 1-D advection – diffusion equation is stated in the above question **Q5** (b). To solve this 1-D equation, Ogata & Banks has suggested the following 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

Compute the relative concentration (c/C_o) if $v_s = 5$ cm/h, $D_{hd} = 2$ cm^2/h for $x = 10$ cm and $t = 1.6$ h.
Use the table in the Appendix for the complementary error function values.

(13 marks)

FINAL EXAMINATION

SEMESTER/SESSION: SEMESTER I/2011/2012 PROGRAMME : 4 BFF
COURSE NAME : GEO-ENVIRONMENT COURSE CODE: BFG 4033

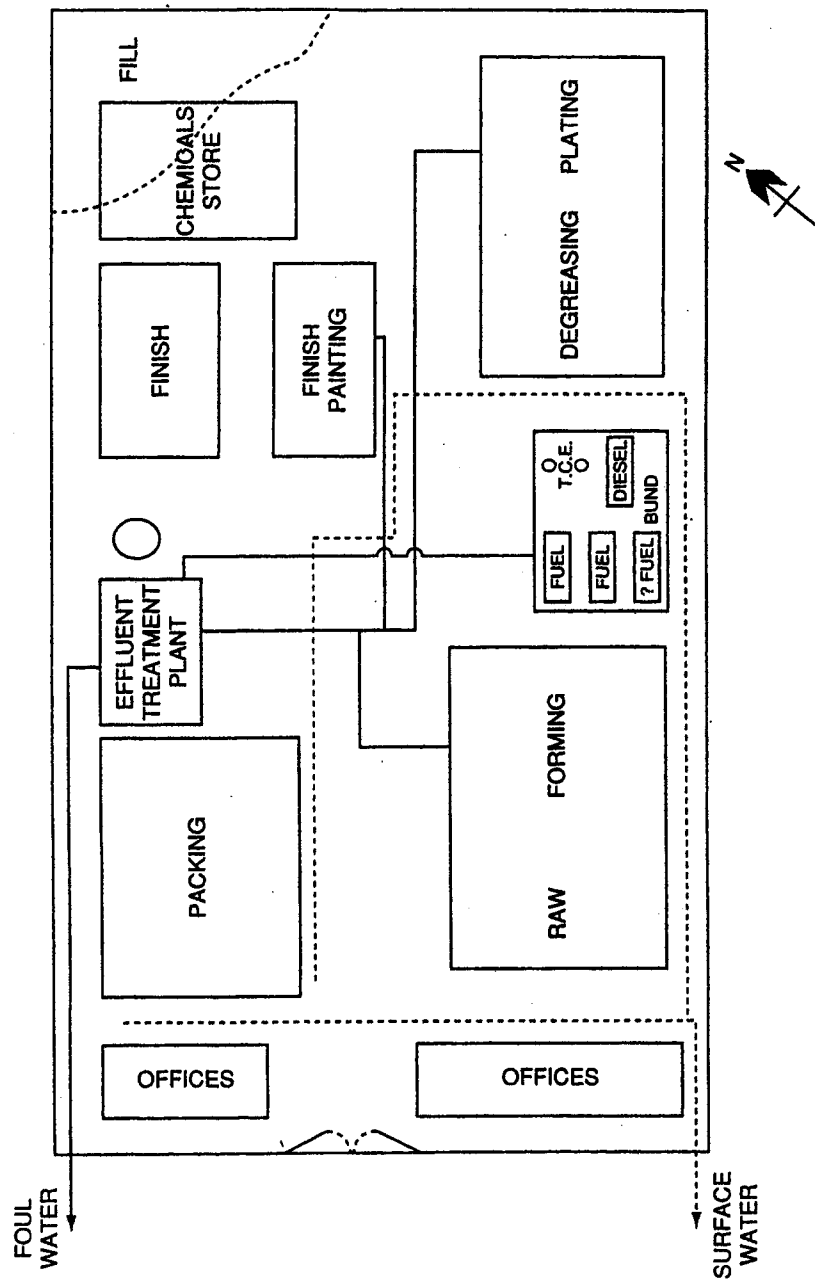

FIGURE Q1

FINAL EXAMINATION

SEMESTER/SESSION: SEMESTER I/2011/2012 PROGRAMME : 4 BFF

COURSE NAME : GEO-ENVIRONMENT COURSE CODE : BFG 4033

Complementary Error Function Table

x	erfc(x)	x	erfc(x)	x	erfc(x)	x	erfc(x)	x	erfc(x)	x	erfc(x)	x	erfc(x)
0	1.000000	0.5	0.479500	1	0.157299	1.5	0.033895	2	0.004678	2.5	0.000407	3	0.00002209
0.01	0.988717	0.51	0.470756	1.01	0.153190	1.51	0.032723	2.01	0.004475	2.51	0.000386	3.01	0.00002074
0.02	0.977435	0.52	0.462101	1.02	0.149162	1.52	0.031587	2.02	0.004281	2.52	0.000365	3.02	0.00001947
0.03	0.966159	0.53	0.453536	1.03	0.145216	1.53	0.030484	2.03	0.004094	2.53	0.000346	3.03	0.00001827
0.04	0.954889	0.54	0.445061	1.04	0.141350	1.54	0.029414	2.04	0.003914	2.54	0.000328	3.04	0.00001714
0.05	0.943628	0.55	0.436677	1.05	0.137564	1.55	0.028377	2.05	0.003742	2.55	0.000311	3.05	0.00001608
0.06	0.932378	0.56	0.428384	1.06	0.133856	1.56	0.027372	2.06	0.003577	2.56	0.000294	3.06	0.00001508
0.07	0.921142	0.57	0.420184	1.07	0.130227	1.57	0.026397	2.07	0.003418	2.57	0.000278	3.07	0.00001414
0.08	0.909922	0.58	0.412077	1.08	0.126674	1.58	0.025453	2.08	0.003266	2.58	0.000264	3.08	0.00001326
0.09	0.898719	0.59	0.404064	1.09	0.123197	1.59	0.024538	2.09	0.003120	2.59	0.000249	3.09	0.00001243
0.1	0.887537	0.6	0.396144	1.1	0.119795	1.6	0.023652	2.1	0.002979	2.6	0.000236	3.1	0.00001165
0.11	0.876377	0.61	0.388319	1.11	0.116467	1.61	0.022793	2.11	0.002845	2.61	0.000223	3.11	0.00001092
0.12	0.865242	0.62	0.380589	1.12	0.113212	1.62	0.021962	2.12	0.002716	2.62	0.000211	3.12	0.00001023
0.13	0.854133	0.63	0.372954	1.13	0.110029	1.63	0.021157	2.13	0.002593	2.63	0.000200	3.13	0.00000958
0.14	0.843053	0.64	0.365414	1.14	0.106918	1.64	0.020378	2.14	0.002475	2.64	0.000189	3.14	0.00000897
0.15	0.832004	0.65	0.357971	1.15	0.103876	1.65	0.019624	2.15	0.002361	2.65	0.000178	3.15	0.00000840
0.16	0.820988	0.66	0.350623	1.16	0.100904	1.66	0.018895	2.16	0.002253	2.66	0.000169	3.16	0.00000786
0.17	0.810008	0.67	0.343372	1.17	0.098000	1.67	0.018190	2.17	0.002149	2.67	0.000159	3.17	0.00000736
0.18	0.799064	0.68	0.336218	1.18	0.095163	1.68	0.017507	2.18	0.002049	2.68	0.000151	3.18	0.00000689
0.19	0.788160	0.69	0.329160	1.19	0.092392	1.69	0.016847	2.19	0.001954	2.69	0.000142	3.19	0.00000644
0.2	0.777297	0.7	0.322199	1.2	0.089686	1.7	0.016210	2.2	0.001863	2.7	0.000134	3.2	0.00000603
0.21	0.766478	0.71	0.315335	1.21	0.087045	1.71	0.015593	2.21	0.001776	2.71	0.000127	3.21	0.00000564
0.22	0.755704	0.72	0.308567	1.22	0.084466	1.72	0.014997	2.22	0.001692	2.72	0.000120	3.22	0.00000527
0.23	0.744977	0.73	0.301896	1.23	0.081950	1.73	0.014422	2.23	0.001612	2.73	0.000113	3.23	0.00000493
0.24	0.734300	0.74	0.295322	1.24	0.079495	1.74	0.013865	2.24	0.001536	2.74	0.000107	3.24	0.00000460
0.25	0.723674	0.75	0.288845	1.25	0.077100	1.75	0.013328	2.25	0.001463	2.75	0.000101	3.25	0.00000430
0.26	0.713100	0.76	0.282463	1.26	0.074764	1.76	0.012810	2.26	0.001393	2.76	0.000095	3.26	0.00000402
0.27	0.702582	0.77	0.276179	1.27	0.072486	1.77	0.012309	2.27	0.001326	2.77	0.000090	3.27	0.00000376
0.28	0.692120	0.78	0.269990	1.28	0.070266	1.78	0.011826	2.28	0.001262	2.78	0.000084	3.28	0.00000351
0.29	0.681717	0.79	0.263897	1.29	0.068101	1.79	0.011359	2.29	0.001201	2.79	0.000080	3.29	0.00000328
0.3	0.671373	0.8	0.257899	1.3	0.065992	1.8	0.010909	2.3	0.001143	2.8	0.000075	3.3	0.00000306
0.31	0.661092	0.81	0.251997	1.31	0.063937	1.81	0.010475	2.31	0.001088	2.81	0.000071	3.31	0.00000285
0.32	0.650874	0.82	0.246189	1.32	0.061935	1.82	0.010057	2.32	0.001034	2.82	0.000067	3.32	0.00000266
0.33	0.640721	0.83	0.240476	1.33	0.059985	1.83	0.009653	2.33	0.000984	2.83	0.000063	3.33	0.00000249
0.34	0.630635	0.84	0.234857	1.34	0.058086	1.84	0.009264	2.34	0.000935	2.84	0.000059	3.34	0.00000232
0.35	0.620618	0.85	0.229332	1.35	0.056238	1.85	0.008889	2.35	0.000889	2.85	0.000056	3.35	0.00000216
0.36	0.610670	0.86	0.223900	1.36	0.054439	1.86	0.008528	2.36	0.000845	2.86	0.000052	3.36	0.00000202
0.37	0.600794	0.87	0.218560	1.37	0.052688	1.87	0.008179	2.37	0.000803	2.87	0.000049	3.37	0.00000188
0.38	0.590991	0.88	0.213313	1.38	0.050984	1.88	0.007844	2.38	0.000763	2.88	0.000046	3.38	0.00000175
0.39	0.581261	0.89	0.208157	1.39	0.049327	1.89	0.007521	2.39	0.000725	2.89	0.000044	3.39	0.00000163
0.4	0.571608	0.9	0.203092	1.4	0.047715	1.9	0.007210	2.4	0.000689	2.9	0.000041	3.4	0.00000152
0.41	0.562031	0.91	0.198117	1.41	0.046148	1.91	0.006910	2.41	0.000654	2.91	0.000039	3.41	0.00000142
0.42	0.552532	0.92	0.193232	1.42	0.044624	1.92	0.006622	2.42	0.000621	2.92	0.000036	3.42	0.00000132
0.43	0.543113	0.93	0.188437	1.43	0.043143	1.93	0.006344	2.43	0.000589	2.93	0.000034	3.43	0.00000123
0.44	0.533775	0.94	0.183729	1.44	0.041703	1.94	0.006077	2.44	0.000559	2.94	0.000032	3.44	0.00000115
0.45	0.524518	0.95	0.179109	1.45	0.040305	1.95	0.005821	2.45	0.000531	2.95	0.000030	3.45	0.00000107
0.46	0.515345	0.96	0.174576	1.46	0.038946	1.96	0.005574	2.46	0.000503	2.96	0.000028	3.46	0.00000099
0.47	0.506255	0.97	0.170130	1.47	0.037627	1.97	0.005336	2.47	0.000477	2.97	0.000027	3.47	0.00000092
0.48	0.497250	0.98	0.165769	1.48	0.036346	1.98	0.005108	2.48	0.000453	2.98	0.000025	3.48	0.00000086
0.49	0.488332	0.99	0.161492	1.49	0.035102	1.99	0.004889	2.49	0.000429	2.99	0.000024	3.49	0.00000080