UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	GEOENVIRONMENT
COURSE CODE	:	BFG40303
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **ALL** QUESTIONS IN PART A 2. ANSWER ANY **TWO (2)** QUESTIONS IN PART B

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

PART A

Q1 (a) One of the main applications of geosynthetic material in mitigating the geoenvironmental problems is by controlling and containing the waste. Briefly explain any TWO (2) main design criteria of a geosynthetic material for waste control and containment.

(8 marks)

(b) Geoenvironmental pollution can be mitigated through various ways. Justify the significant of source control in mitigating the pollution caused by sanitary landfill.

(10 marks)

(c) Geoenvironmental engineer is required to determine required thickness of a smooth HDPE primary geomembrane as containment for sanitary landfill.

Design the required thickness of a smooth HDPE primary geomembrane by using the given information:

- Unit weight of solid waste is assumed as $12.5 kN/m^3$
- Maximum height of landfill is 40 m
- Localized subsoil settlement is estimated to result in a liner deformation angle of 20°
- Drainage sand (Ottawa sand) will be placed above the geomembrane and a layer of geonet will be installed below it
- The yield stress of HDPE (for out-of-plane) tension is conservatively estimated as 20,000 kPa
- Peak friction values and efficiencies of various geosynthetic interfaces are listed in **Table Q1**
- Embedment depth curves versus applied normal stress for HDPE is illustrated in **Figure Q1**
- Given that

$$thickness\ of\ geomembrane, t = \frac{\sigma_n x(tan\delta_U + tan\delta_L)}{\sigma_{allow}(cos\beta - sin\beta tan\delta_L)}$$

(7 marks)

Q2 (a) (i) Briefly explain the differences between "diffusion" and "dispersion" when referring to the transportation of contaminants in subsurface environment.

(5 marks)

(ii) Illustrate with diagram the effect of contaminant transport mode (dispersion) on the concentration of contaminant.

(5 marks)

(b) Explain and illustrate the flow process of nonaqueous phase liquids (NAPL) from a leaking tank into fractured rock.

(5 marks)

(c) (i) Compute the average flux density, J of salt in the downstream direction. Apply the data given as stated below.

Salt concentration in river – 40 mg/liter
Average river velocity – 150 cm/s

(4 marks)

(ii) Dispersion can be demonstrated in laboratory studies in which water moves at a known velocity, v, through porous media. Predict the concentration of salt after 45 minutes at a distance of 0.8m down the column. Apply the data given as stated below.

Mean grain size of sand - approximately 0.5 mm
Seepage velocity of water flows through column – 1m/hr
Porosity of sand – 0.3
Dimension of cylindrical column – 1.5 m in length x 10 cm in diameter
Amount of salt injected into the column – 5 mg

(6 marks)

Part B

Q3 (a) (i) List down any **THREE (3)** types of geological materials that are suitable for accommodating radioactive waste.

(3 marks)

(ii) Briefly explain the characteristics of any **TWO (2)** geological materials that are answered earlier which make it suitable for accommodating radioactive waste.

(6 marks)

(b) Propose suitable construction works for disposal storage of sewage from sanitary landfill. The proposed works should take into consideration its stability and containment.

(10 marks)

(c) It was reported that landfill leachate had accidentally discharged to a nearby river because of flash flood. Predict the expected problems for the local fishing industries.

(6 marks)

Q4 (a) The liquid phase is generally composed of water and is therefore commonly known as soil water or pore water. The soil water may exist in three different types.

(i) Name **THREE (3)** types of soil water.

(3 marks)

(ii) Briefly explain each type of soil water named earlier.

(6 marks)

(b) Strength of fine-grained soils is reported to be affected by the fabric of fine-grained soils. Briefly discuss the effect of soil fabric towards the strength of fine grained soils.

(8 marks)

(c) It was reported that soil type A (organic Clay) and soil type B (inorganic Sand) were artificially spiked with contaminants. Predict the adsorption level of contaminants in soils by referring to its chemical properties.

(8 marks)

Q5 (a) (i) Name the **FOUR (4)** phases commonly adopted for site characterization.

(4 marks)

(ii) Categorise the relevant site investigation works under phase II and phase IV site characterization.

(4 marks)

(b) (i) List down **TWO (2)** additional aspects required when proposing site investigation works for contaminated sites comparing to conventional geotechnical site characterization.

(2 marks)

(ii) Propose necessary works to define the boundary of the contaminated area. Please answer it from the aspect of chemical data analysis.

(6 marks)

(c) Plan a series of suitable soil sampling works to sample contaminated soil samples for obtaining physical and chemical data.

(9 marks)

–END OF QUESTIONS–

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TABLE Q1: Peak friction values and efficiencies of various geosynthetic interfaces

(a) Soil-to-Geomembrane Friction Angles

Geomembrane	Soil type: Concrete Sand ($\phi = 30°$)		Ottawa Sand ($\phi = 28°$)		Mica Schist Sand ($\phi = 26°$)	
HDPE						
Textured	30°	(100%)	26°	(92%)	22°	(83%)
Smooth	18°	(56%)	18°	(61%)	17°	(63%)
PVC						
Rough	27°	(88%)	—	—	25°	(96%)
Smooth	25°	(81%)	—	—	21°	(79%)
CSPE-R	25°	(81%)	21°	(72%)	23°	(87%)

(b) Geomembrane-to-Geotextile Friction Angles

Geotextile	Geomembrane: HDPE Textured	HDPE Smooth	PVC Rough	PVC Smooth	CSPE-R Undulating
Nonwoven needle-punched	32°	8°	23°	21°	15°
Nonwoven heat-bonded	28°	11°	20°	18°	21°
Woven monofilament	19°	6°	11°	10°	9°
Woven slit-film	32°	10°	28°	24°	13°

(c) Soil-to-Geotextile Friction Angles

Geotextile	Soil type: Concrete Sand ($\phi = 30°$)		Ottawa Sand ($\phi = 28°$)		Mica Schist Sand ($\phi = 26°$)	
Nonwoven needle-punched	30°	(100%)	26°	(92%)	25°	(96%)
Nonwoven heat-bonded	26°	(84%)	—	—	—	—
Woven monofilament	26°	(84%)	—	—	—	—
Woven slit-film	24°	(77%)	24°	(84%)	23°	(87%)

*Efficiency percentages (in parentheses) are based on Equations (5.8) at (5.9).

Source: Extended from Martin et al. [18].

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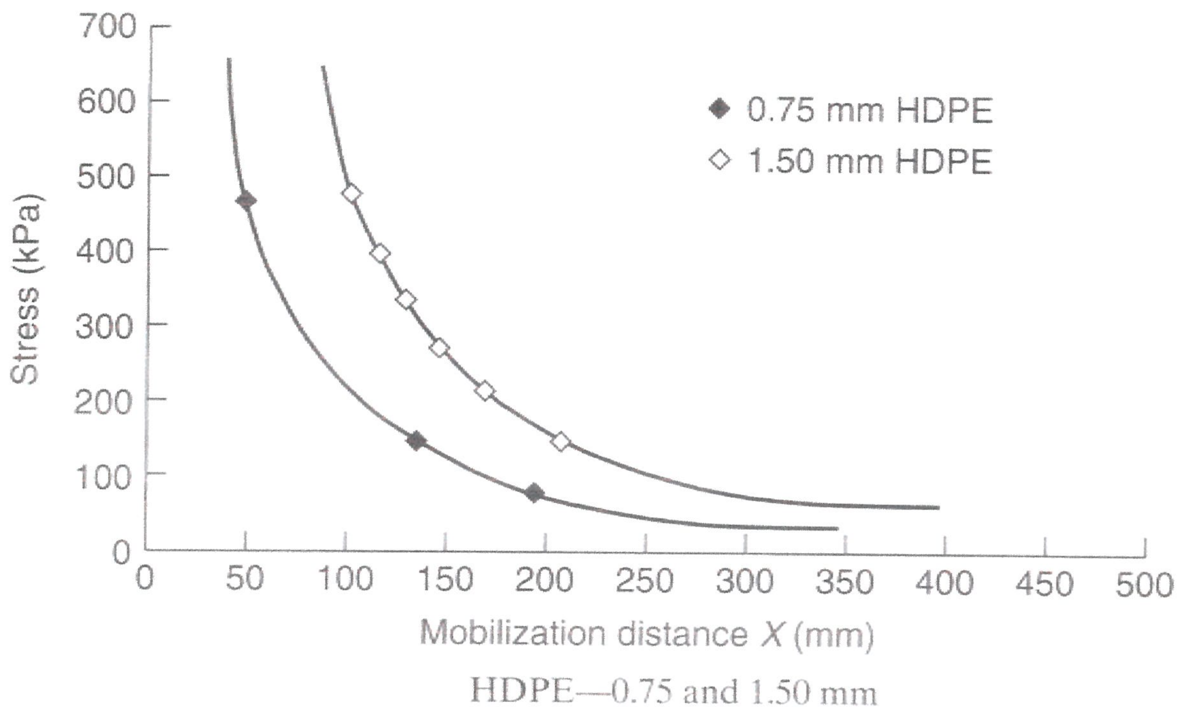

FIGURE Q1: Embedment depth curves versus applied normal stress for HDPE

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Formula:

$$D = \alpha V$$

$$C(x, t) = \frac{M_a}{n\sqrt{4\pi D_L t}} e^{\frac{-(x-vt)^2}{(4D_L t)}}$$

$$C(x) = \frac{M_a}{n\sqrt{4\pi \alpha x'}}$$