First Semester Examination
Academic Session 2018/2019

December 2018/January 2019

EAH417 – Urban Water Management
(Pengurusan Air Bandar)

Duration : 2 hours
(Masa : 2 jam)

Please check that this examination paper consists of **TEN (10)** pages of printed material including appendix before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEPULUH (10)** muka surat yang bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]*

Instructions : This paper consists of **SIX (6)** questions. Answer **FOUR (4)** questions.

*[**Arahan** : Kertas ini mengandungi **ENAM (6)** soalan. Jawab **EMPAT (4)** soalan.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

(1). (a). Rational Method is widely used to determine peak flow for the design of the drainage system. Discuss on the assumption and constraint of the Rational Method in the determination of the peak flow.

Kaedah Rasional digunakan dengan meluas dalam menentukan puncak kadaralir untuk rekabentuk sistem perparitan. Bincangkan anggapan dan kekangan kaedah Rasional dalam menentukan puncak kadaralir.

[10 marks/*markah*]

(b). The landuse for mixed development project over 75 ha in Alor Setar consists of: recreational area with grass covers 25%; Bungalow residential area 25%; Link and teracce houses 25%; and Commercial area 25% of the total area. Determine the composite Rational coefficient C, and the peak discharge for 10 year ARI from the development area. Determine the volume of the runoff from the whole development area based on the Rational method and triangular hydrograph. Use time of concentration of 30 minute.

Guna tanah pembangunan bercampur seluas 75 ha di Alor Setar terdiri dari: kawasan rekreasi yang berumput 25%; perumahan bunglo 25%; perumahan bersambung dan teres 25%; dan kawasan komersial 25% dari seluruh kawasan pembangunan. Tentukan pekali Rasional komposit dan puncak kadaralir untuk 10 tahun ARI dari seluruh kawasan pembangunan tersebut. Tentukan ispadu air larian langsung dari seluruh kawasan pembangunan tersebut berdasarkan kaedah Rasional dan hidrograf tiga segi. Gunakan masa penumpuan selama 30 minit.

[15 marks/*markah*]

(2). (a). An area of 5000 ha in Kedah, is designated for eco-city development which consists of golf course, high end bungalow residential, school and commercial areas. The client specifies for sustainable drainage system to be incorporated in the development and shall be designed based on train of treatment for water quantity/quality control. The development area is flat and the soil is sandy with infiltration rate in excess of 50 mm/hr. Discuss and propose the concept and framework for the sustainable drainage system. Select **FOUR (4)** appropriate devices to comply with quantity control of the sustainable drainage system.

Kawasan seluas 5000 ha di Kedah akan dibangunkan sebagai bandar eco yang terdiri dari padang golf, bunglo kos tinggi, sekolah dan kawasan komersial. Klien telah mengariskan untuk menerapkan sistem saliran mesra alam di dalam pembangunan tersebut dan rekabentuknya adalah berdasarkan kepada rawatan bersiri untuk kawalan kuantiti/kualiti air ribut. Kawasan pembangunan adalah rata dan tanah berpasir dengan keupayaan penyusupan adalah lebih dari 50 mm/jam. Bincangkan dan cadangkan konsep dan rangka kerja sistem saliran mesra alam. Pilih ***EMPAT (4)*** *kaedah yang sesuai untuk memenuhi kawalan kuantiti sistem saliran mesra alam.*

[12 marks/*markah*]

(b). A petrol station will be developed on 5000 m^2 lot area in Nibong Tebal Pulau Pinang. An above ground storage will be provided on the lawn area at the front of the site. The impervious area consists of pump station building, perimeter road and carparks which are 90% of the project area. The lawns and garden cover 10% of the project area. Determine the permissible site discharge (PSD) for the above ground onsite detention (OSD). Assume the followings in the calculation: t_c = 0.5 hr, t_{cs} = 0.25 hr, $^5I_{30}$ = 120 mm/hr, Q_p = 0.10 m^3/s and, Q_a = 0.15 m^3/s.

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Stesen petrol akan dibangunkan di sebuah lot seluas 5000 m^2 di Nibong Tebal, Pulau Pinang. Kemudahan OSD di atas permukaan tanah dicadangkan untuk disediakan pada kawasan lanskap di hadapan tapak stesen tersebut. Kawasan tidak telap terdiri dari bangunan pam stesen, jalan perimeter dan tempat letak kereta yang mempunyai keluasan 90% dari kawasan projek. Kawasan lanskap dan taman mempunyai keluasan 10% dari kawasan projek. Tentukan aliran keluar dari tapak yang dibenarkan (PSD) untuk OSD di atas permukaan tanah tersebut. Anggapkan perkara berikut untuk pengiraan: t_c = 0.5 hr, t_{cs} = 0.25 hr, $^5I_{30}$ = 120 mm/hr, Q_p = 0.10 m^3/s dan , Q_a = 0.15 m^3/s.

[13 marks/*markah*]

(3). (a). Determine the main characteristic in designing infiltration basin.
Tentukan ciri utama dalam merekabentuk takungan penyusupan.

[5 marks/*markah*]

(b). Estimate the preliminary size of an infiltration basin proposed for a housing development in Jawi, Pulau Pinang. The catchment area is 10.12 ha with 65% of impervious area. The site condition of pre-development is palm oil plantations. From initial site investigation, the characteristic of the catchment is as follows:

Anggarkan saiz permulaan suatu kolam penyusupan yang dicadangkan untuk pembangunan perumahan di Jawi, Pulau Pinang. Kawasan tadahan adalah 10.12 ha dengan 65% kawasan yang tidak telap. Keadaan tapak pra-pembangunan adalah ladang kelapa sawit. Dari penyiasatan tapak awal, ciri takungan adalah seperti berikut:

Use the following assumptions:
Gunakan andaian-andaian yang berikut:

Soil type : Sandy loam

Jenis tanah : lom berpasir

Infiltration capacity (f_c): 35 mm/hr

Kapasiti penyusupan (fc): 35 mm/hr

Ground water level: 4.2 m (below ground surface)

Paras air bawah tanah : 4.2 m (bawah permukaan tanah)

Time of concentration pre-development, t_{cs}= 45 minutes

Masa penumpuan pra-pembangunan, t_{cs} = 45 minit

Time of concentrations, t_c = 30 minutes

Masa tumpuan, t_c= 30 minit

Porosity of sandy loam, *n* = 0.35

Keliangan lom berpasir, n = 0.35

Maximum storage time, T_s = 24 hr

Waktu penyimpanan maksima, T_s = 24 jam

Effective filling time, T_f = 2 hr

Masa pengisian yang berkesan, T_f = 2 jam

Rainfall intensity/*Intensiti hujan* $i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}}$

State	No.	Station	Station Name	Constants			
				λ	κ	θ	η
Penang	1	5204048	Sg Simpang Ampat Tangki	59.3122	0.3394	0.3350	0.8090

WQV = C_{ave} (P_d) A

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The volume of a trapezoidal shaped basin:

$$V = \frac{(A_b + A_t)d_b}{2}$$

A_t = Top surface area of the basin (m^2);

A_b = Bottom surface area of the basin (m^2); and

d_b = Basin depth (m).

The bottom length and width of the basin:

$$L_b = L_t - 2Z d_b$$

$$W_b = W_t - 2Z d_b$$

L_b = Basin bottom length (m);

W_b = Basin bottom width (m);

L_t = Basin top length (m);

Wt = Basin top width (m); and

Z = Specified side slope ratio (H:V).

[20 marks/*markah*]

(4). (a). Describe the principle of removal mechanisms in a wet pond.
Terangkan prinsipal mekanisma penyahan di dalam sebuah takung basah.

[10 marks/*markah*]

(b). Refering to **Table 1**, describe why an engineer who designs a water quality treatment facility requires the knowledge of local site condition and pollutants generated. Please provide **TWO (2)** examples of treatment facilities and their principle of pollutant removal.

*Merujuk **Jadual 1**, terangkan mengapa seorang jurutera kejuruteraan air merekabentuk sebuah fasiliti rawatan kualiti air memerlukan pengetahuan tempatan tentang keadaan tapak dan bahan cemar yang dihasilkan. Sila nyatakan **DUA (2)** contoh fasiliti rawatan dan prinsip penyingkiran pencemaran oleh fasiliti tersebut.*

Table 1: Selection of BMPs for Various Pollutants (DID 2012)

BMPs Type	Pollutant Removal Efficiency			Other Factors			
	Gross pollutants	TSS	Nutrient (tN & TP)	Maintenance	Land Required	Treatable Catchment Area	Cost
Infiltration	Low	High	High	Medium	High	Medium	Low
Bioretention	Low	High	High	Low	Medium	Medium	Medium
Swale	Low	Medium	Medium	Low	Low	Low	Low
GPT	High	Low	No	Medium	Medium	Medium	Medium
Water Quality Pond	Medium	Medium	Medium	Medium	High	High	High
Wetlands	Medium	High	High	High	Medium	High	High

[15 marks/*markah*]

(5). As a qualified engineer, you have to design a swale on a proposed 5 hectare bungalow development in Batu Pahat, Johor. Discuss in details the design consideration and requirements for this project. With the aid of sketch diagram, explain the advantages and disadvantages of swale drain.

Sebagai seorang jurutera yang berkelayakan, anda dikehendaki untuk merekabentuk longkang rumput atas tapak cadangan pembangunan 5 hektar di Batu Pahat, Johor. Bincangkan dengan jelas pertimbangan rekabentuk dan keperluan bagi projek ini. Dengan bantuan gambarajah lakaran, jelaskan kebaikan dan kelemahan saliran berumput.

[25 marks/*markah*]

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(6). Determine the size of a lined concrete rectangular drain to convey a 20-year ARI minor system design flow from a proposed 15 hectare shop houses development in Batu Pahat. The post-development time of concentration, t_c at the development outlet is estimated to be 1800 seconds. Propose drain design with dimensions. (n = 0.015, drain longitudinal slope is 1 in 200)

Tentukan saiz parit konkrit segi empat tepat untuk menyalurkan ARI 20 tahun sistem minor dari cadangan pembangunan rumah kedai 15 hektar di Batu Pahat. Masa tumpuan selepas pembangunan, t_c di outlet pembangunan dianggarkan 1800 saat. Cadangkan reka bentuk parit dengan dimensi. (n = 0.015, cerun membujur longitudinal adalah 1 dalam 200)

[25 marks/*markah*]

APPENDIX/ *LAMPIRAN*

Selected Equations for rainfall intensity, overland flow and OSD.

$i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}}$
$t_o = \frac{107 n^* L^{1/3}}{S^{1/5}}$
$PSD = \frac{a - \sqrt{a^2 - 4b}}{2}$
$a = \left(4\frac{Q_a}{t_c}\right)\left(0.333 t_c \frac{Q_p}{Qa} + 0.75 t_c + 0.25 t_{cs}\right)$
$b = 4 Q_a Q_p$
$SSR = 0.06 t_d (Q_d - c - d)$
$c = 0.875\, PSD\left(1 - 0.459\frac{PSD}{Q_d}\right)$
$d = 0.214\frac{PSD^2}{Q_d}$

Fitting Constant for Design Rainfall Estimation (Alor Setar Station)

λ	κ	θ	η
64.832	0.168	0.346	0.800

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State	No.	Station ID	Station Name	Constants			
				λ	κ	θ	η
Johor	1	1437116	Stor JPS Johor Bahru	59.972	0.163	0.121	0.793
	2	1534002	Pusat Kem. Pekan Nenas	54.265	0.179	0.100	0.756
	3	1541139	Johor Silica	59.060	0.202	0.128	0.660
	4	1636001	Balai Polis Kg Seelong	50.115	0.191	0.099	0.763
	5	1737001	SM Bukit Besar	50.554	0.193	0.117	0.722
	6	1829002	Setor JPS Batu Pahat	64.099	0.174	0.201	0.826
	7	1834124	Ladang Ulu Remis	55.864	0.166	0.174	0.810
	8	1839196	Simpang Masai K. Sedili	61.562	0.191	0.103	0.701
	9	1931003	Emp. Semberong	60.568	0.163	0.159	0.821
	10	2025001	Pintu Kaw. Tg. Agas	80.936	0.187	0.258	0.890
	11	2033001	JPS Kluang	54.428	0.192	0.108	0.740
	12	2231001	Ladang Chan Wing	57.188	0.186	0.093	0.777
	13	2232001	Ladang Kekayaan	53.457	0.180	0.094	0.735
	14	2235163	Ibu Bekalan Kahang	52.177	0.186	0.055	0.652
	15	2237164	Jalan Kluang-Mersing	56.966	0.190	0.144	0.637
	16	2330009	Ladang Labis	45.808	0.222	0.012	0.713
	17	2528012	Rmh. Tapis Segamat	45.212	0.224	0.039	0.711
	18	2534160	Kg Peta Hulu Sg Endau	59.500	0.185	0.129	0.623
	19	2636170	Setor JPS Endau	62.040	0.215	0.103	0.592

Runoff Coefficient

Landuse	Runoff Coefficient (C)	
	For Minor System (≤10 year ARI)	For Major System (> 10 year ARI)
Residential		
Bungalow	0.65	0.70
Semi-detached Bungalow	0.70	0.75
Link and Terrace House	0.80	0.90
Flat and Apartment	0.80	0.85
Condominium	0.75	0.80
Commercial and Business Centres	0.90	0.95
Industrial	0.90	0.95
Sport Fields, Park and Agriculture	0.30	0.40
Open Spaces		
Bare Soil (No Cover)	0.50	0.60
Grass Cover	0.40	0.50
Bush Cover	0.35	0.45
Forest Cover	0.30	0.40
Roads and Highways	0.95	0.95
Water Body (Pond)		
Detention Pond (with outlet)	0.95	0.95
Retention Pond (no outlet)	0.00	0.00

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