First Semester Examination
2019/2020 Academic Session

December 2019 / January 2020

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 **FIVE (5)** questions. Answer **FOUR (4)** questions.

*[**Arahan** : Kertas ini mengandungi **LIMA (5)** 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.

[8 marks/*markah*]

(b). The approach in designing urban drainage system has changed from rapid disposal approach to control at source. Discuss on the **FOUR (4)** advantages of control at source approach for urban drainage system.

*Pendekatan dalam rekabentuk sistem saliran bandar telah berubah dari kaedah pembuangan cepat kepada kawalan di punca. Bincangkan **EMPAT (4)** kelebihan kaedah kawalan di punca untuk sistem saliran bandar.*

[8 marks/*markah*]

(c). The land use for mixed development project over 100 ha in Alor Setar consists of recreational area (open space with grass covers) 25%; bungalow residential area 25%; link and teracce houses 35% and commercial area 15% of the total area. Determine the composite Rational coefficient, C and the peak discharge for 10 year ARI from the development area. Based on the Rational method and triangular hydrograph, determine the volume of the runoff from the whole development area. Use time of concentration of 30 minute.

Guna tanah pembangunan bercampur seluas 100 ha di Alor Setar terdiri dari kawasan rekreasi (ruang terbuka yang berumput) 25%; perumahan banglo 25%; perumahan bersambung dan teres 35% dan kawasan komersial 15% dari seluruh kawasan pembangunan. Tentukan pekali Rasional komposit dan puncak kadaralir untuk 10 tahun ARI dari seluruh kawasan pembangunan tersebut. Berdasarkan kaedah Rasional dan hidrograf tiga segi tentukan isipadu air larian lansung dari seluruh kawasan pembangunan tersebut. Gunakan masa penumpuan selama 30 minit.

[9 marks/*markah*]

(2). (a). An area of 6000 ha in Perak, is designated for eco-city development which consists of golf course, high end bungalow residential, school and commercial area. 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 80 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 6000 ha di Perak akan dibangunkan sebagai bandar eko yang terdiri dari padang golf, banglo 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 80 mm/jam. Bincangkan dan cadangkan konsep dan rangka kerja sistem saliran mesra alam. Pilih **EMPAT (4)** peranti yang sesuai untuk memenuhi kawalan kuantiti sistem saliran mesra alam.*

[10 marks/*markah*]

(b). A fast outlet restaurant will be developed on 5000 m^2 lot area in Bukit Mertajam, Penang. An above ground storage will be provided on the lawn area at the front of the site. The impervious area consists of restoran building, perimeter road and carparks which are 90% of the project area. The lawns and garden cover 10% of the project area. Calculate the volume of site storage requirement (SSR) for the above ground onsite detention (OSD). Based the calculation by assuming t_c = 0.5 hr, t_{cs} = 0.25 hr, t_d = 0.25 hr, Q_p = 0.10 m^3/s, Q_a = 0.15 m^3/s and Q_d = 0.25 m^3/s.

Restoran makanan segera akan dibangunkan di sebuah lot seluas 5000 m^2 di Bukit Mertajam Pulau Pinang. Kemudahan di atas permukaan tanah dicadangkan untuk disediakan pada kawasan lanskap di hadapan tapak restoran tersebut. Kawasan tidak telap terdiri dari bangunan restoran, jalan perimeter dan tempat letak kereta yang mempunyai keluasan 90% dari kawasan projek. Kawasan lanskap dan taman mempunyai keluasan 10% dari kawasan projek. Kirakan isipadu keperluan storan tapak (SSR) untuk OSD di atas permukaan tanah tersebut. Anggapkan perkara berikut untuk pengiraan: t_c = 0.5 j, t_{cs} = 0.25 j, t_d = 0.25 j, Q_p = 0.10 m^3/s, Q_a = 0.15 m^3/s, dan Q_d = 0.25 m^3/s.

[15 marks/*markah*]

(3). (a). Describe how to design a water quality pond.

Huraikan bagaimana untuk rekabentuk kolam kualiti air.

[5 marks/*markah*]

(b). With help of a sketch diagram, explain why a wet pond is effective in pollutants removal.

Dengan bantuan lakaran gambarajah terangkan mengapa kolam basah berkesan dalam penyingkiran bahan pencemaran.

[5 marks/*markah*]

(c). Estimate the preliminary sizes of a BMPs treatment train in order to reduce TSS by 80% from a residential subcatchment at Taman Bertam Perdana located in Sg Bertam catchment, with an area of 12.5 ha as shown in **Figure 1**. The average contributing imperviousness of the residential area is 70%. Use the design charts in the **Appendix**.

*Anggarkan saiz awal rawatan BMP bersiri untuk mengurangkan TSS sebanyak 80% dari subtadahan kediaman di Taman Bertam Perdana yang terletak di kawasan tadahan Sg Bertam, dengan keluasan 12.5 hektar seperti yang ditunjukkan dalam **Rajah 1**. Purata sumbangan kawasan tidak telap di kawasan kediaman adalah 70%.* Guna carta rekabentuk dalam **Lampiran**.

[15 marks/*markah*]

Figure 1: Layout of the Proposed BMPs Treatment Train in Bertam Perdana

Rajah 1: Susun atur cadangan rawatan bersiri BMP di Bertam Perdana

(4). 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 swale 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 parit swale.

[25 marks/*markah*]

(5). Determine the size of a lined concrete rectangular drain to convey a 20-year ARI major 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 30 minutes. Propose the design diagram of drain with dimensions (n = 0.015, drain longitudinal slope is 1 in 200).

Tentukan saiz parit segi empat tepat konkrit untuk menyalurkan ARI 20 tahun sistem major dari cadangan pembangunan rumah kedai 15 hektar di Batu Pahat. Masa tumpuan selepas pembangunan, t_c di outlet pembangunan dianggarkan 30 minit. Cadangkan reka bentuk parit dengan gambarajah lakaran beserta 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 (Batu Pahat Station)

λ	κ	θ	η
64.832	0.168	0.346	0.800

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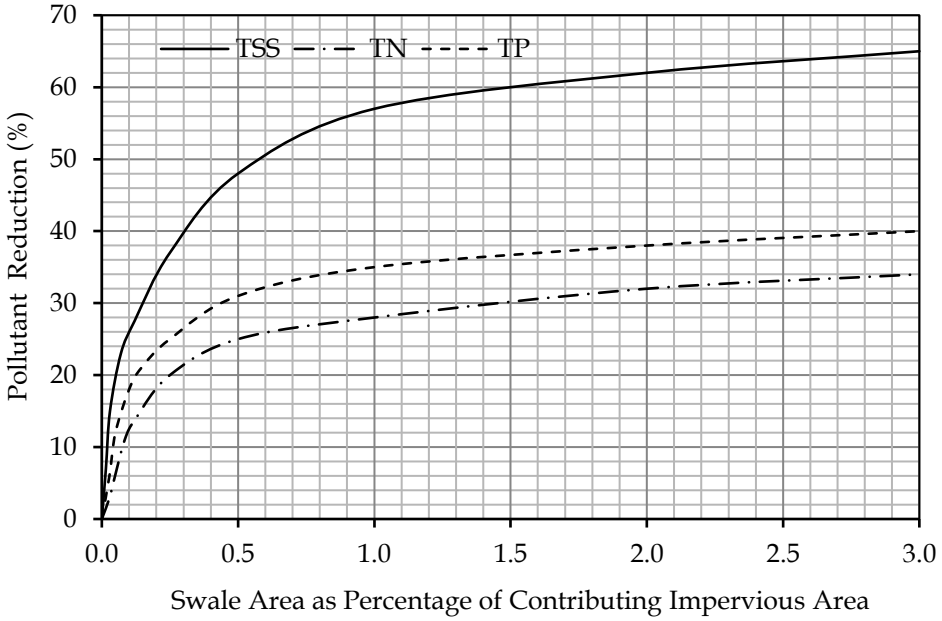
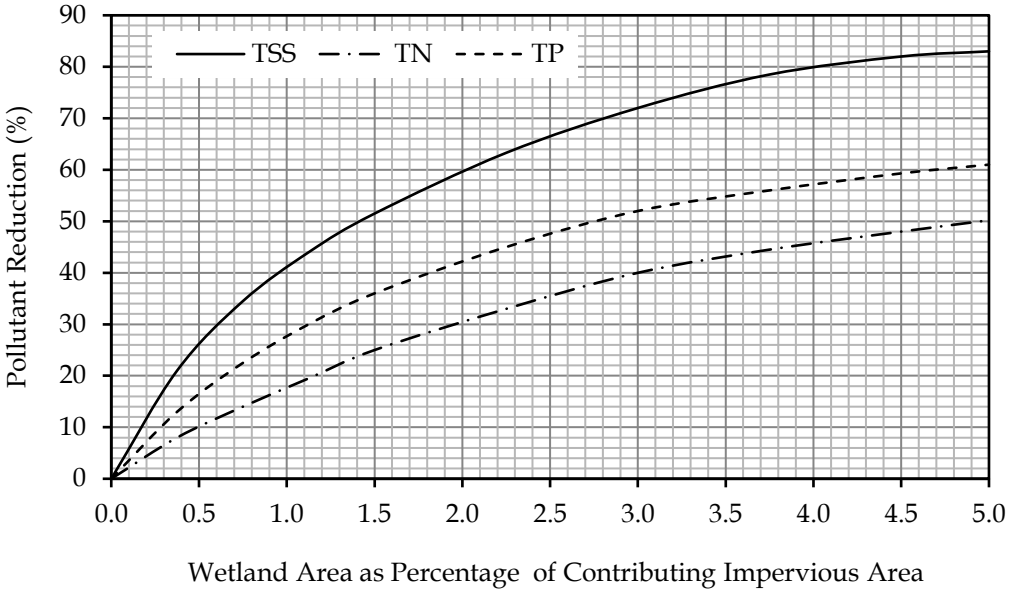
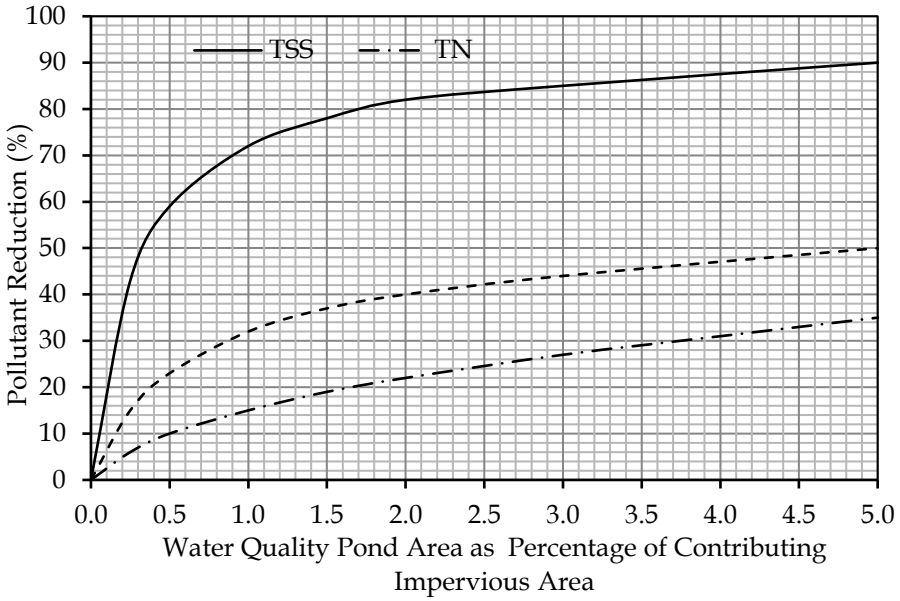
Runoff Coefficient

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




TSS
TN
TP
Pollutant Reduction (%)
0
10
20
30
40
50
60
70
80
90
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Wetland Area as Percentage of Contributing Impervious Area


TSS
TN
Pollutant Reduction (%)
0
10
20
30
40
50
60
70
80
90
100
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Water Quality Pond Area as Percentage of Contributing Impervious Area

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

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
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Water Body (Pond)		
Detention Pond (with outlet)	0.95	0.95
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