UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008

April 2008

EAH 422/4 - Water Resources Engineering
[*Kejuruteraan Sumber Air Lanjutan*]

Duration: 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **TEN (10)** printed pages including appendices before you begin the examination.
*[Sila pastikan kertas peperiksaan ini mengandungi **SEPULUH (10)** muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]*

Instructions: This paper contains **FIVE (5)** questions. Answer **FOUR (4)** questions only. All questions carry the same marks.

*[**Arahan**:Kertas ini mengandungi **LIMA (5)** soalan. Jawab **EMPAT (4)** soalan sahaja. Semua soalan membawa jumlah markah yang sama.]*

You may answer the question either in Bahasa Malaysia or English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

All questions **MUST BE** answered on a new page.
*[Semua soalan **MESTILAH** dijawab pada muka surat baru.]*

Write the answered question numbers on the cover sheet of the answer script.
[Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.]

1.(a) Describe the followings term in irrigation systems:

i. Water Balance Concept
ii. The relationship between soil characteristics and moisture content
iii. The concept of Crop Water Requirement
iv. Efficiency and Uniformity in irrigation system

(8 marks)

Terangkan yang berikut dalam terma sistem pengairan

i. Konsep imbangan air
ii. Hubungan ciri-ciri tanah dengan lembapan tanah
iii. Keperluan Air Tanaman
iv. Kecekapan dan Kesegaraman sistem pengairan

(8 markah)

(b) Table 1 shows the data on daily evapo-transpiration (ET) and effective rainfall (Pe) for a four hectare farm started January 29 till February 7. The root depth zone is 75 cm and management allowable deficit (MAD) is 20%, field capacity (f_c) is 30% and the initial field capacity (f_o) is 20% on the early morning on the 29 January. Determine the dates for irrigation or drainage required by the irrigation system. Determine also the quantity of water required if the irrigation efficiency is 70%.

(17 marks)

Jadual 1 menunjukkan data bagi sejatpeluh (ET) dan hujan efektif (Pe) harian untuk sebuah ladang empat hektar bermula dari 29 Januari sehingga 7 Februari. Kedalaman zon akar adalah 75cm dan kandungan lembab tapak diurus (MAD) adalah 20%, kelembapan lapangan (f_c) adalah 30% dan kelembapan awal (f_o) adalah 20% pada pagi 29 Januari.Tentukan tarikh untuk pengairan atau saliran yang diperlukan oleh sistem pengairan tersebut Tentukan juga jumlah air yang diperlukan sekiranya kecekapan pengairan adalah 70%.

(17 markah)

Date	ET (cm)	Pe (mm)
29 January	0.838	
30 January	0.831	1.27
31 january	0.660	
1 February	0.737	
2 February	0.762	
3 February	0.838	
4 February	0.584	18.0
5 February	0.762	15.0
6 February	0.640	8.2
7 February	0.86	

Table 1/Jadual 1

2. (a) Determine the application efficiency for corn, banana and the overall farm from these followings information :

i. Each day only 0.6 ha of corn and 1 ha of banana is irrigated
ii. Required available Water (RAW) for corn is 8 cm
iii. Required available Water (RAW) for banana 15 cm
iv. Corn is irrigated for 26 rows with 19L/min each row
v. Banana is irrigated for 70 rows with 27L/min each row

Assume the uniform water distribution. Explain why banana has lower application efficiency than corn?

(10 marks)

Kira kecekapan penggunaan bagi jagung, pisang dan ladang tersebut dari informasi berikut :

i. Setiap hari seluas 0.6 ha jagung dan 1 ha pisang diairkan
i. Keperluan air (RAW) untuk jagung adalah 8 sm
ii. Keperluan air (RAW) untuk pisang 15 sm
iii. Jagung diairkan bagi 26 batas dengan 19L/min setiap satu
iv. Pisang diairkan bagi 70 batas dengan 27L/min setiap satu

Andaikan air dibekalkan sekata pada lading Terangkan mengapa pisang mempunyai keupayaan penggunaan yang lebih rendah dari jagung?

(10 *markah)*

(b) i. Briefly describe the concept and assumption of the time-area method for deriving the direct runoff hydrograph.

(5 marks)

i. Terangkan dengan ringkas konsep dan anggapan kaedah luas-masa untuk menerbitkan hidrograf aliran terus.

(5 markah)

ii. Post development time-area curve and design rainfall (50 yr ARI) for area with 20 hectare and time of concentration 30 min (for post development condition) are given in table below. Derive the post development hydrograph for the developed area.

Design Rainfall Isohyet (50 year ARI)

Time (min)	Rainfall (mm)	Losses (mm)
5	18.0	5.0
10	25.0	2.5
15	30.0	2.5
20	32.5	2.5
25	20.0	2.5
30	16.0	2.5

Time-area Curve (Cumulative Area)

Area (m^2)	Time (min)
26000	5
56000	10
106000	15
146000	20
176000	25
200000	30

(10 marks)

ii. *Lengkung luas-masa pasca pembangunan dan hujan rekabentuk (50 tahun ARI untuk suatu kawasan seluas 20 hektar dengan masa penumpuan (pascan pembangunan) 30 minit diberikan dalam jadual dibawah. Anggarkan hidrograf pasca pembangunan untuk kawasan pembangunan tersebut.*

Isohiet Hujan Rekabentuk (50 tahun ARI)

Masa (min)	*Hujan (mm)*	*Kehilangan (mm)*
5	*18.0*	*5.0*
10	*25.0*	*2.5*
15	*30.0*	*2.5*
20	*32.5*	*2.5*
25	*20.0*	*2.5*
30	*16.0*	*2.5*

Lengkung Luas-masa (Luas Kumulatif)

Luas (m^2)	*Masa (min)*
26000	*5*
56000	*10*
106000	*15*
146000	*20*
176000	*25*
200000	*30*

(10markah)

3. (a) Describe **five (5)** characteristic, for on-site detention facility.

(5 marks)

*Terangkan **lima (5)** ciri-ciri storan di tapak (OSD).*

(5 markah)

(b) A residential house is proposed on an area with 547 m^2 in Kota Raya. Developer proposes an OSD to be provided on the lawn area at the front of the house. The Rational Coefficient for pervious area (C_{pr}), impervious (C_{ip}), critical storm (Q_d,10 year ARI), land use and design rainfall polynomial coefficient for the whole development area of 547 m^2 in Kota Raya are given in the Table 2 below. To meet the requirement for water quantity control, determine the following:

i. peak discharge for predevelopment condition
ii. peak discharge for post development condition
iii. permissible site discharge (PSD)
iv. volume of OSD required.

Hydrological Data

C_{pr} (kawasan lanskap/taman)	C_{ip} (kawasan bumbung/berturap)	t_c	t_{cs}	Q_d	t_d
0.43	0.90	30 min	20 min	22.6 l/s	15 min

Land Use Data

Kediaman	Garaj	Jalan Masuk berturap	Kawasan berturap	Lanskap dan Taman
115.7 m^2	30.2 m^2	40.6 m^2	49.5 m^2	311.0 m^2

Design Rainfall Polynomial Coefficient

a	b	c	d
4.775	0.598	-0.231	0.012

Table 2

(20 marks)

(b) Sebuah rumah kediaman akan dibangunkan di suatu kawasan seluas 547 m^2 di Kota Raya. Untuk memenuhi kawalan kuantiti air ribut kemudahan OSD dicadangkan untuk disediakan pada kawasan lanskap di hadapan rumah kediaman tersebut. Pekali Rational untuk kawasan telap (C_{pr}) dan tidak telap (C_{ip}), air ribut kritikal (Q_d, 10 tahun ARI), guna tanah dan pekali polynomial hujan rekabentuk untuk keseluruhan kawasan seluas 547 m^2 di Kota Raya diberikan pada Jadual 2. Untuk memenuhi kawalan kuantiti air ribut tentukan perkara berikut:

i. puncak kadaralir pra-pembangunan
ii. puncak kadaralir pasca –pembangunan
iii. aliran keluar dari tapak yang dibenarkan (PSD)
iv. isipadu OSD yang diperlukan.

Data Hidrologi

C_{pr} *(kawasan lanskap/taman)*	C_{ip} *(kawasan bumbung/berturap)*	t_c	t_{cs}	Q_d	t_d
0.43	*0.90*	*30 min*	*20 min*	*22.6 l/s*	*15 min*

Guna tanah

Kediaman	*Garaj*	*Jalan Masuk berturap*	*Kawasan berturap*	*Lanskap dan Taman*
115.7 m^2	*30.2 m^2*	*40.6 m^2*	*49.5 m^2*	*311.0 m^2*

Pekali Polinomial Hujan Rekabentuk di Kota Jaya (2 tahun ARI)

a	*b*	*c*	*d*
4.775	*0.598*	*-0.231*	*0.012*

Jadual 2

(20 markah)

$$PSD = \frac{a - \sqrt{a^2 - 4b}}{2}$$

$$a = 4\left(\frac{Q_a}{t_c}\right)\left(0.333t_c\frac{Q_p}{Q_a} + 0.75t_c + 0.25t_{cs}\right)$$

$$b = 4Q_aQ_p$$

$$SSR = 0.06t_d(Q_d - c - d)$$

$$c = 0.875PSD\left(1 - 0.459\frac{PSD}{Q_d}\right)$$

$$d = 0.214\frac{PSD^2}{Q_d}$$

4. A bridge that will be built across the Kelantan River in Tanah Merah Town has the following characteristics:
Sebuah jambatan akan dibina merentasi Sungai Kelantan di Bandar Tanah Merah. Ciri-ciri aliran sungai adalah berikut:

Q	=	350 m^3/s
B	=	75 m
y_3	=	3 m

Flow direction of the river is perpendicular to the bridge, with the characteristics of bridge piers as given below:
Arah aliran sungai adalah bersudut tepat dengan jambatan. Ciri-ciri pier adalah seperti berikut:

Bentuk/ *shape* = 

Bilangan pier / *number of piers* = 4

L/a = 4

a = 3 m

(a) The rise up of water level at upstream of the bridge

(11 marks)

Kenaikan paras air di hulu jambatan.

(11 markah)

(b) Check if the design discharge is able to pass through the mentioned bridge

(7 marks)

Semak jika luahan rekabentuk dapat melalui bawah jambatan tersebut.

(7 markah)

(c) Calculate the maximum scour depth around the bridge pier using the Modified Colorodo State University method. Assume the bed material size D_{50} is 1.0 mm with small dune

(7 marks)

Kira kedalaman maksimum keruk di sekitar pier dengan menggunakan kaedah Modified Colorodo State University. Andaikan saiz bahan dasar D_{50} sebagai 1.0 mm dengan dune yang kecil.

(7 markah)

5.(a) What is meant by water resources planning? Please describe briefly its purpose, goals and policies.

(5 marks)

Apakah yang dimaksudkan sebagai perancangan sumber air? Bincangkan dengan ringkas tujuannya.

(5 markah)

(b) Discuss briefly the **THREE (3)** water resources planning methodology terms.

(7 marks)

*Bincangkan dengan ringkas **TIGA (3)** metodologi perancangan sumber air.*

(7 markah)

(c) Discuss briefly the **FOUR (4)** planning classes used in water resources planning.

(10 marks)

*Bincangkan dengan ringkas **EMPAT (4)** pengkelasan perancangan yang digunakan dalam perancangan sumber air.*

(10 markah)

(d) Discuss briefly the overall water management concept.

(3 marks)

Bincangkan dengan ringkas model konsep pengurusan air keseluruhan organisasi perancangan sumber air.

(3 markah)

Pier Shape	K	Remarks
Semicircular nose and tail	0.90	All values applicable for piers with length to breadth ratio equal to 4; conservative estimates of Δy have been found for larger ratios
Lens-shaped nose and tail	0.90	
Twin-cylinder piers with connecting diaphragm	0.95	
Twin cylinder piers without diaphragm	1.05	Lens-shaped nose is formed from 2 circular curves, each of radius to twice the pier width and each tangential to a pier face
90° triangular nose and tail	1.05	
Square nose and tail	1.25	

Type of pier	Conveyance Ratio, σ									
	0.9		0.8		0.7		0.6		0.5	
	K_N	K_A	K_N	K_A	K_N	K_A	K_N	K_A	K_N	K_A
Square nose and tails	0.91	0.96	0.87	1.02	0.86	1.02	0.87	1.00	0.89	0.97
Semicircular nose and tails	0.94	0.99	0.92	1.13	0.95	1.20	1.03	1.26	1.11	1.31
90° triangular nose and tails	0.95		0.94		0.92					
Twin-circular piers with/without diaphragms	0.91		0.89		0.88					
Lens-shaped nose and tails	0.95	1.00	0.94	1.14	0.97	1.22				

Table 1.
Correction Factor K_1

Shape of pier nose	K_1
(a) Square nose	1.1
(b) Round nose	1.0
(c) Circular cylinder	1.0
(d) Sharp nose	0.9
(e) Group of cylinders	1.0

Table 2.
Correction Factor K_2

B	L/a = 4	L/a = 8	L/a = 12
0	1.0	1.0	1.0
15	1.5	2.0	2.5
30	2.0	2.75	3.5
45	2.3	3.3	4.3
90	2.5	3.9	5.0

B = skew angle of flow

Table 3. Increase in Pier scour depths (K_3)		
Bed Condition	**Dune Height**	**K_3**
Clear- water scour	N/A	1.1
Plane bed and antidune flow	N/A	1.1
Small dunes	10> H > 2	1.1
Medium dunes	30 > H > 10	1.1 – 1.2
Large dunes	H > 30	1.3

Table 4. Correction factor K_4, for Armouring by D_{90} size				
	D_{50} (mm)	**D_{90} / D_{50} ≥**	**V_c / V_1 ≥**	**K_4**
Sand	< 2	-		1.0
Gravel	2 – 32	-		1.0
Gravel	32 – 64	4-3	2.0	0.95
Cobbles	64 – 250	3-2	1.5	0.90
	250 – 500	2 – 1	1.5	0.85
	>500	1	1.5	0.80

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