UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2009/2010

November 2009

EAH 422/4 – Advanced Water Resources Engineering
[Kejuruteraan Sumber Air Lanjutan]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **FOURTEEN (14)** printed pages
including appendix before you begin the examination.
*[Sila pastikan kertas peperiksaan ini mengandungi **EMPAT BELAS (14)** muka surat
bercetak sebelum anda memulakan peperiksaan ini.]*

Instructions: This paper consists of **SEVEN (7)** questions. Answer **FIVE (5)** questions
only. All questions carry the same marks.

*[**Arahan**: Kertas ini mengandungi **TUJUH (7)** soalan. Jawab **LIMA (5)** 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.]

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

*[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa
Enggeris hendaklah diguna pakai]*

1. a) i) What is an irrigation and explain its necessity in a tropical country like Malaysia? What are the advantages, disadvantages and ill effect of assured irrigation?

(6 marks)

   ii) Derive the relationship between available water and readily available water.

(4 marks)

   b) The moisture content at field capacity of a Clay Loam soil is 25% (by weight). Assume the permanent wilting point is 12% (by weight) and root zone depth is 100 cm with the bulk density is $1.4g/cm^3$. Calculate the net and gross depth of irrigation required if the irrigation efficiency is 70 %.

(10 marks)

2. i) Describe **THREE (3)** differences between rapid disposal and control at source approaches.

(3 marks)

   ii) Discuss on the **THREE (3)** approaches of control at source for stormwater quantity control and the related devices for each approach.

(7 marks)

   iii) Discuss on the concept and principle of designing the onsite detention (OSD) facility for water quantity control.

(10 marks)

3. i) Discuss on the outlet control for the community and regional pond for quantity control design principle.

(5 marks)

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 and determined the preliminary estimate of the detention pond for 50 year ARI. The allowable outflow rate is 8 m^3/s.

$$V_S = 1.291 \ V_i \left(1 - \frac{Q_o}{Q_i} \right)^{0.753} \left(\frac{t_i}{t_p} \right)^{-0.411}$$

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

Table 1 : Design Rainfall Isohyet (50 year ARI)

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

Table 2 : Time-area Curve (Cumulative Area)

(15 marks)

4. a) Discuss the concept of water resources sustainability as defined by Brundtland Commission Report (1987), i.e.;

   "Sustainable water resources as the ability to provide and manage water quantity and quality so as to meet the present needs of humans and environmental ecosystems, while not imparing the needs of future generations to do the same."

   (3 marks)

   b) Discuss the **FIVE (5)** important facets of water resources sustainability and water sustainability towards human existence.

   (5 marks)

   c) Gleick et al (1995) defined "sustainable water as the use of water that supports the ability of human society to endure and flourish into the indefinite future without undermining the integrity of the hydrological cycle or the ecological systems that depend on it".

   Discuss the **SEVEN (7)** requirements for sustainable water.

   (7 marks)

   d) Two alternative water resources projects are being considered. The respective cost and benefits are given in the Table 3. Project A has been anticipated life of 35 years, and the useful life of Project B has been estimated to be 25 years. If the Minimum Attractive Rate of Return (MARR) is 9% per year, which project is suitable? In this case, the effects of inflation are negligible.

   .

	Project A	*Project B*
Investment cost	750,000	625,000
Annual operating and maintenance cost	120,000	110,000
Annual benefit	245,000	230,000
Useful life of project	35	25

Table 3

(5 marks)

5. a) Water management organizational arrangements center around public and private sector activities. There are **SEVEN (7)** levels of government or type of water industry. Discuss in brief **FIVE (5)** of the levels.

(5 marks)

b) Discuss **FIVE (5)** purposes and functions of water resources development.

(5 marks)

c) It was stated that the objectives of water resources development are embodied in the general political-social objectives. Discuss the political statement, an economic statement and economic indicators of objectives for a water resource development.

(10 marks)

6. a) A bridge that will be built across a River has following characteristics.

Discharge (Q) is $= 500 m^3/s$

Pier width (b) is $= 100m$

Flow depth (y3) is $= 3m$

Shape of pier is rounded nose

Number of pier is $= 4$

Rates L/a is 4 and a is a $= 3m$

Check discharge is able to pass through the proposed bridge. Calculate the maximum scour depth around the bridge pier using the Modified Colorado State University method by assuming the bed material size is 1.0m.

(10 marks)

b) The overfall spillway length is 200m and has been designed for head of 2.8m. Determine will be the discharge for heads of 0.20m and 1.5m. Determine is the maximum discharge that can be passed through this spillway (assuming the dam free board is high enough and the spillway is well constructed without cavitation).
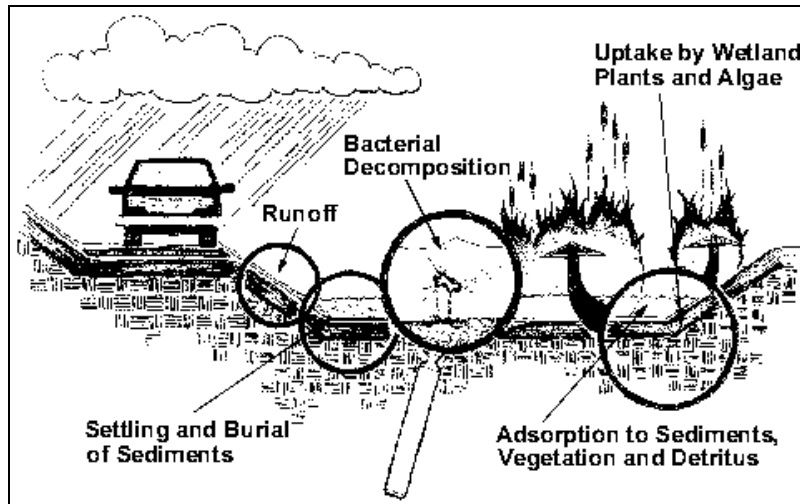
(10 marks)

Figure 1

7. a) i) Describe the treatment mechanism in a retention pond as shown in Figure 1.

   ii) Describe the concepts of treatment train and the longest path in stormwater quality treatment.

   (5 marks)

   b) A community infiltration basin had been proposed in Damansara to treat stormwater from a residential area. The catchment area is 25 ha with 15 ha is impervious area and the rest is playing field and garden. Assume the site condition of pre-development is a rubber estate.

   From the initial investigation, the characteristic of the catchment are:
   Soil type is sandy loam
   Infiltration capacity is 0.035m/hr
   Time of concentration for predevelopment is 45 minutes
   Time of concentration for development is 30 minutes
   Infill materials has maximum porosity of 0.35

   If assume maximum storage time is 24 hours and effective filling time is 2 hours, determine the size of the proposed community infiltration basin.

   (15 marks)

1. a) i) Apa itu saliran pengairan dan terangkan keperluannya dalam negara beriklim tropika seperti Malaysia?. Terangkan dengan ringkas kelebihan, keburukan dan kesan buruk akibat saliran pengairan.

(6 marks)

   ii) Beri definasi air sediada (AW – available water) dan RAW (readily available water) dan jelaskan hubungan keduanya.

(4 markah)

   b) Kandungan lembapan tanah lempung liat (clay loam soil) pada muatan ladang (field capacity) adalah 25% per satuan berat. sementara itu takat kelayuan kekal (wilting point) 12% persatuan berat. kedalaman zon akar adalah 100 cm dan the bulk density is 1.4 g/cm^3. hitung kedalaman kasar dan bersih keperluan saliran pengairan, bila kecekapan (efficiency) saliran pengairan 70%.

(10 markah)

2. i) Nyatakan **TIGA (3)** perbezaan di antara pendekatan pembuangan cepat dan kawalan di punca.

(3 markah)

   ii) Bincangkan **TIGA (3)** pendekatan di dalam kawalan di punca untuk kawalan kuantiti air ribut dan peralatan yang berkaitan untuk setiap pendekatan.

(7 markah)

   iii) Bincangkan konsep dan prinsip dalam rekabentuk kemudahan storan setempat (OSD) untuk kawalan kuantiti air ribut.

(10 markah)

3. i) Bincangkan tentang kawalan alur keluar untuk kolam tahanan komuniti dan regional untuk prinsip rekabentuk kawalan kuantiti.

(5 markah)

ii) Lengkung luas-masa pasca pembangunan dan hujan rekabentuk (50 tahun ARI) untuk suatu kawasan seluas 20 hektar dengan masa penumpuan (pasca pembangunan) 30 minit diberikan dalam jadual di bawah. Anggarkan hidrograf pasca pembangunan untuk kawasan pembangunan tersebut dan hitung anggaran awal kolam tahanan untuk 50 tahun ARI. Aliran keluar yang dibenarkan adalah 8 m^3/s.

$$V_s = 1.291 \, V_i \left(1 - \frac{Q_o}{Q_i}\right)^{0.753} \left(\frac{t_i}{t_p}\right)^{-0.411}$$

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

Jadual 1 : Isohiet Hujan Rekabentuk (50 tahun ARI)

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

Jadual 2 : Lengkung Luas-masa (Luas Kumulatif)

(15 markah)

4. a) *Bincangkan konsep kelestarian sumber air yang ditakrifkan oleh Brundtland Commission Report (1987) , iaitu :*

    "Sustainable water resources as the ability to provide and manage water quantity and quality so as to meet the present needs of humans and environmental ecosystems, while not imparing the needs of future generations to do the same. "

    (3 markah)

    b) *Bincangkan* **LIMA (5)** *kepentingan impak kelestarian sumber air dan kelestarian air terhadap kehidupan manusia.*

    (5 markah)

    c) *"Gleick et al (1995) telah mentakrifkan kelestarian air sebagai "the use of water that supports the ability of human society to endure and flourish into the indefinite future without undermining the integrity of the hydrological cycle or the ecological systems that depend on it."*

    Bincangkan **TUJUH (7)** *keperluan kelestarian air yang berkaitan.*

    (7 markah)

    d) *Dua projek sumber air alternative sedang dipertimbangkan. Kos dan kelebihan setiap projek disenaraikan dalam jadual di bawah. Projek A dijangka mempunyain hayat selama 35 tahun, dan hayat berguna projek B dijangka selama 25tahun. Jika Kadar Pulangan Minima Menarik (MARR) ialah 9% setahun, projek mana yang sesuai. Untuk pengiraan ini, kesan inflasi boleh diabaikan.:*

	Projek A	Projek B
Kos pelaburan	750,000	625,000
Kos selenggara dan operasi tahunan	120,000	110,000
Kelebihan tahunan	245,000	230,000
Hayat berguna projek	35	25

Jadual 3

(5 markah)

5. a) *Pengurusan air susunan organisasi berkaitan dengan aktiviti sektor awam dan persendirian. Terdapat* **TUJUH (7)** *tahap kerajaan atau jenis industri air. Bincang sekurang-kurangnya* **LIMA (5)** *tersebut.*

(5 markah)

b) *Bincangkan sekurang-kurangnya* **LIMA (5)** *sebab dan fungsi pembangunan sumber air.*

(5 markah)

c) *Adalah dinyatakan bahawa objektif pembangunan sumber air adalah kerana matlamat politik-sosial secara amnya. Bincangkan kenyataan politik, kenyataan ekonomi dan penunjuk ekonomi untuk objektif-objektif pembangunan sumber air.*

(10 markah)

6. a) *Sebuah jambatan yang akan dibina merentasi River mempunyai ciri-ciri berikut.*

   Melaksanakan (kadar aliran), Q = 5000 m^3/s,

   kelebaran jeti, B = 100m dan

   kedalaman aliran, y3 = 3 m
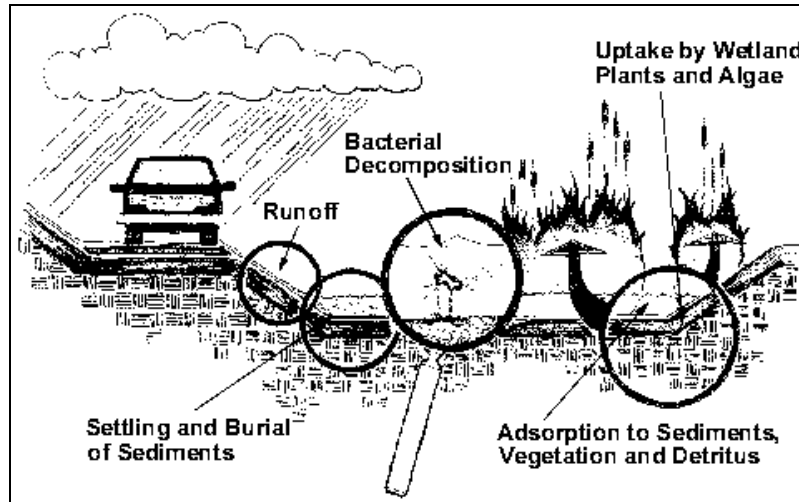
   Bentuk jeti hidung bulat.

   jumlah jeti = 4 .

   L / satu = 4 dan a = 3 m

   Memeriksa kadar alir rekabentuk adalah celus jambatan disebut. Menghitung maksimum menggosok kedalaman sekitar tembok sambut jambatan menggunakan kaedah Modified Colorado State University. Menganggap bahan dasar saiz adalah 1.0 mm.

   (10 markah)

   b) *Pelimpah panjang alur limpah = 200m telah direka untuk kepala 2.8 m. Apa akan menjadi pelepasan untuk ketua-ketua 0.20 m dan 1.5 m, dan apakah pelepasan maksimum yang boleh menjadi terlepas perhatian alur limpah ini (menganggap empangan lambung-bebas menjadi cukup tinggi dan alur limpah menjadi dibina dengan baik) tanpa peronggaan?*

   (10 markah)

Rajah 1

7. a) *Merujuk kepada Rajah 1 di atas, terangkan mekanisma rawatan di kolam takungan. Terangkan konsep 'treatment train' dan 'the longest path' dalam rawatan kualiti air ribut.*

(5 markah)

b) *Sebuah kolam komuniti penyusupan telah dicadangkan di Damansara untuk merawat air larian ribut dari kawasan perumahan. Jumlah kawasan tadahan adalah 25 ha dan 15 ha darinya adalah kawasan berturap dan selebihnya adalah kawasan permainan dan taman. Andaikan kawasan sebelum pembangunan adalah sebuah estet getah.*

Dari kajian awal tapak, ciri ciri berikut ditemui:

Jenis tanah adalah 'Sandy Loam'

Kapasiti penyusupan adalah 0.035m/jam

Masa tumpu sebelum pembangunan adalah 45 minit

Masa tumpu selepas pembangunan adalah 30 minit

Masimum porositi tanih adalah 0.35

Andaikan masa storan maksimum adalah 24 jam dan masa tepu efektif adalah 2 jam, tentukan saiz cadangan kolam komuniti penyusupan tersebut.

(15 markah)

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APPENDIX / *LAMPIRAN*