UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	URBAN STORMWATER MANAGEMENT
COURSE CODE	:	BFW 4053 / BFW 40503
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

Q1 (a) Discuss briefly the effects of runoff quality and quantity as a result of the transformation to an urbanized area.

(5 marks)

(b) A 8000 m^2 area is to be developed comprising of a landscape area and pavement as shown in **Figure Q1 (a)**. As a team member of the appointed consultant company, you are assigned to design the 'Vee' shaped grass swale at the boundary of the developed area (**Figure Q1 (b)**. The information required for a proper design of the 'Vee' shaped grass swale is shown in **Table Q1 (b)**. Proposed the proper 'Vee' shaped grass swale design, sketch and label the dimension values obtained. Check that velocity of the swale shall not exceed 2 m/s.

(15 marks)

Q2 (a) Discuss in general the importance of having rainfall temporal patterns in the hydrologic design.

(5 marks)

(b) Construct the 60 minutes design rainfall depth at 100 years ARI for Segamat, Johor district. Show your result graphically in temporal pattern fraction.

(10 marks)

(c) Based on **Q2 (b),** report your peak discharge value and the time for it to occur from your drawn graph if the area known is 25 hectares.

(5 marks)

Q3 (a) Urban Stormwater Manual for Malaysia (USMM) has stated that some adjustment should be done to obtain the rainfall intensity design for the catchment that exceeds 10 km^2. Based on your justification, discuss why that assumption should be considered.

(5 marks)

(b) A study area located in Segamat, Johor comprises six catchments, which are drained by a sewer system as shown in **Figure Q3 (b)**. The characteristics of the catchments are shown in **Table Q3 (b).** The length of Pipe 1, Pipe 2 and Pipe 3 are 360 m, 300 m and 420 m respectively. The velocity of flow in all pipes can be assumed to be 1 m/s. Use the rational method to determine 10 year discharges in Pipe 1, Pipe 2, Pipe 3 and the outflow from the area.

(15 marks)

Q4 (a) Explain briefly with the aid of a sketch the concept of retention as an onsite retention system.

(6 marks)

(b) A wet extended detention pond size for the required water quality volume will be used to illustrate the sizing procedure for an extended-detention orifice. Based on the following information, calculate the required orifice size for water quality design of different method analysis :-

(i) Method 1 - Maximum hydraulic head with routing
(ii) Method 2 - Average hydraulic head and average discharge

Judge your outputs in term of the designed sizes. Given :-

Water Quality volume, (WQV)	0.76 ac-ft = 33,106 ft^3
Maximum hydraulic head, (H_{max})	5.0 ft (from stage versus storage data)
Average hydraulic head, (h_{avg})	2.5 ft (from stage versus storage data)

(14 marks)

Q5 (a) Determine the bypass flow of the curved vane grate inlet (W = 1.5 m and L = 1.0 m) located in a triangular gutter if S_x = 0.02, S_l = 0.01, T = 2.5 m and Q = 0.85 m^3/s. Calculate the efficiency of this grate. Determine the required length for the curve vane grate which would intercept 75 % of the gutter flow. Given that K_u =0.0556.

(12 marks)

(b) A concrete box culvert (1.5 m × 1.5 m × 17 m with 45° wingwalls and a square edge at the crown) has slope of 1 % and n = 0.012. If the tailwater depth is 1.02 m, analyze the headwater depth for a flow rate of 50 m^3/s. Check both of inlet and outlet control conditions by sketching your illustration outputs. Given that, k_s = 0.7, k_e = 0.5, k_n = 1.0 $^{1/3}/s$, K_1 = 0.1475 and M_1 = 1.0.

(8 marks)

Q6 (a) Differentiate the primary functions of the following BMPs and describe the similarity of:-

(i) Filter strips (grassed)
(ii) Grassy swale

(6 marks)

(b) Discuss the occurrence of water erosion that was caused by falling raindrops to the whole process which involves the detachment of soil materials, transport of soil materials, and deposition of eroded materials. Conclude the important things which erosion and sediment can be controlled effectively.

(5 marks)

(c) List down the planning project using the Erosion and Sediment Control (ESC) method. Classify **TWO (2)** erosion control devices and **THREE (3)** sediment control devices.

(9 marks)

-END OF QUESTION-

S1 (a) Bincangkan dengan ringkas kesan-kesan kualiti dan kuantiti air larian permukaan hasil daripada pertukaran kepada kawasan perbandaran.

(5 markah)

(b) Sebuah kawasan 8000 m^2 akan dibangunkan mengandungi kawasan landskap dan berturap seperti ditunjukkan di dalam **Rajah S1 (a)**. Sebagai ahli bagi sebuah syarikat perunding, anda dilantik untuk merekabentuk saliran berumput berbentuk 'Vee' di sempadan kawasan dibangunkan (**Rajah Q1 (b)**. Maklumat diperlukan untuk merekabentuk saluran berumput berbentuk 'Vee' yang sesuai seperti ditunjukkan dalam **Jadual S1(b).** Cadangkan rekabentuk saliran berumput berbentuk 'Vee' yang sesuai, lakar dan labelkan nilai-nilai dimensi yang diperolehi. Semak halaju saliran berumput tidak melebihi 2 m/s.

(15 markah)

S2 (a) Bincangkan secara umum kepentingan adanya corak-corak hujan membabitkan masa di dalam rekabentuk hidrologi.

(5 markah)

(b) Bina rekabentuk kedalaman hujan 60 minit pada kala kembali 100 tahun untuk daerah Segamat, Johor. Tunjukkan keputusan anda secara grafik dalam bentuk pecahan membabitkan masa.

(10 markah)

(c) Berpandukan soalan S2 (b), laporkan nilai kadar alir puncak dan masanya untuk berlaku daripada graf yang anda lukis sekiranya luas diketahui 25 hektar.

(5 markah)

S3 (a) Manual Saliran Mesra Alam Malaysia (MSMA) telah menggariskan pelarasan perlu dilakukan untuk mendapatkan keamatan hujan rekabentuk bagi kawasan tadahan yang melebihi 10 km^2. Berdasarkan justifikasi anda, bincangkan mengapa andaian tersebut perlu dipertimbangkan.

(5 markah)

(b) Sebuah kawasan kajian terletak di Segamat, Johor mengandungi enam kawasan tadahan yang dialirkan oleh sistem kumbahan seperti ditunjukkan dalam **Rajah S3 (b)**. Panjang Paip 1, Paip 2 dan Paip 3 ialah masing-masing 360 m, 300 m and 420 m. Halaju aliran di dalam semua paip boleh dianggap sebagai 1 m/s. Menggunakan kaedah rasional tentukan kadar alir 10 tahun di dalam Paip 1, Paip 2, Paip 3 dan kadar alir keluar dari kawasan ini.

(15 markah)

S4 (a) Terangkan secara ringkas dengan berbantukan lakaran konsep sistem tahanan di tapak.

(6 markah)

(b) Satu saiz kolam takungan basah lanjutan untuk keperluan isipadu kualiti air akan digunakan untuk menggambarkan ukuran saiz orifis pada kolam lanjutan tersebut. Berdasarkan maklumat berikut, kirakan saiz orifis yang diperlukan untuk rekabentuk kualiti air bagi kaedah analisis yang berbeza :-

(i) Kaedah 1 - Ketinggian hidraulik maksimum dengan penghalaan
(ii) Kaedah 2 - Purata ketinggian hidraulik dan purata kadaralir

Pertimbangkan hasil anda berdasarkan saiz yang direkabentuk. Diberi :-

Isipadu Kualiti air, (WQV)	0.76 ekar-kaki = 33,106 kaki^3
Ketinggian hidraulik maksimum, (H_{max})	5.0 kaki (dari tapak hingga data simpanan)
Purata Ketinggian hidraulik, (h_{avg})	2.5 kaki (dari tapak hingga data simpanan)

(14 markah)

S5 (a) Kirakan aliran pintas bagi *grate inlet* (W = 1.5 m dan L = 1.0 m) dipasang di dalam saluran segitiga jika S_x = 0.02, S_L = 0.01, T = 2.5 m dan Q = 0.85 m^3/s. Kira keberkesanan *grate inlet* ini. Tentukan panjang yang diperlukan untuk *curve vane grate* yang akan mencapai kemasukan aliran pada 75 % di dalam saluran. Diberi K_u = 0.0556.

(12 markah)

(b) Satu pembentung konkri segiempat (1.5 m x 1.5 m × 17 m dengan 45° penahan tepi dan bucu pada puncaknya) mempunyai kecerunan 1 % dan n = 0.012. Jika kedalaman hilir ialah 1.02 m, analisa kedalaman hulu bagi kadaralir 50 m^3/s. Semak kedua-dua kedalaman hulu bagi keadaan kawalan air masuk dan keluar dengan melakarkan hasil kiraan anda. Diberi, k_x = 0.7, k_e = 0.5, k_n = 1.0 $^{1/3}$/s, K_1 = 0.1475 dan M_1 = 1.0.

(8 markah)

S6 (a) Bezakan fungsi utama BMPs berikut dan terangkan keserupaan daripada:-
(i) Alur bertapis (berumput) */Filter strips (grassed)*
(ii) Saluran berumput (*Grassy swale*)

(6 markah)

(b) Bincangkan kejadian hakisan air yang disebabkan oleh hujan terhadap keseluruhan proses yang melibatkan kandungan tanah, pengangkutan bahan dalam tanah, dan pemendapan bahan hakisan. Simpulkan perkara penting yang mana hakisan dan mendapan boleh dikawal secara berkesan.

(5 markah)

(c) Senaraikan perancangan projek menggunakan kaedah Kawalan Hakisan dan Mendapan (ESC). Kelaskan **DUA (2)** peranti kawalan hakisan dan **TIGA (3)** peranti kawalan mendapan.

(9 markah)

-SOALAN TAMAT-

APPENDIX I

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2012/2013
COURSE NAME : URBAN STORMWATER MANAGEMENT
PROGRAMME : 4 BFF
COURSE CODE : BFW 4053 / BFW 40503

TABLE / *JADUAL*

Table Q1(b) / *Jadual S1 (b)*

Peak discharge, Q_p	0.15 m^3/s
Side slopes, z	5
Manning's roughness, *n*	0.035
Channel slope, S_o	0.001
Freeboard	150 mm
Allowable velocity limit, *v*	2 m/s

Table Q2 (a) : Temporal patterns – West Coast of Peninsular Malaysia
Jadual S2 (a) : Bentuk Taburan – Pantai Barat Semenanjung Malaysia

Duration (min)	No. of Time Periods	Fraction of Rainfall in Each Time Period											
10	2	0.570	0.430	-	-	-	-	-	-	-	-	-	-
15	3	0.320	0.500	0.180	-	-	-	-	-	-	-	-	-
30	6	0.160	0.250	0.330	0.090	0.110	0.060	-	-	-	-	-	-
60	12	0.039	0.070	0.168	0.120	0.232	0.101	0.089	0.057	0.048	0.031	0.028	0.017
120	8	0.030	0.119	0.310	0.208	0.090	0.119	0.094	0.030	-	-	-	-
180	6	0.060	0.220	0.340	0.220	0.120	0.040	-	-	-	-	-	-
360	6	0.320	0.410	0.110	0.080	0.050	0.030	-	-	-	-	-	-

Table Q2 (b) : Standard durations for urban stormwater drainage
Jadual S2 (b) : Tempoh piawai untuk saliran hujan ribut bandar

Standard duration (minutes)	Number of time intervals	Time intervals (minutes)
10	2	5
15	3	5
30	6	5
60	12	5
120	8	15
180	6	30
360	6	60

APPENDIX II

FINAL EXAMINATION

SEMESTER / SESSION	: SEM II / 2012/2013	PROGRAMME	: 4 BFF
COURSE NAME	: URBAN STORMWATER MANAGEMENT	COURSE CODE	: BFW 4053 / BFW 40503

TABLE / *JADUAL*

Table Q2 (c): Coefficients for the IDF equations for Segamat, Johor district ($30 \leq t \leq 1000$ min)
Jadual S2 (c): Pekali untuk formula IDF bagi Daerah Segamat, Johor ($30 \leq t \leq 1000$ min)

ARI (year)	a	b	c	d
2	3.0293	1.4428	-0.3924	0.0232
5	4.2804	0.9393	-0.3161	0.0200
10	6.2961	-0.1466	-0.1145	0.0080
20	7.3616	-0.6982	-0.0131	0.0021
50	7.4417	-0.6247	-0.0364	0.0041
100	8.1159	-0.9379	-0.0176	0.0013

Table Q2 (d): Values of adjustment factor, F_D for West Coast and East Coast of Peninsular Malaysia
Jadual S2 (d): Nilai pelarasan faktor, F_D untuk Pantai Barat dan Pantai Timur Semenanjung Malaysia

Duration	$^2P_{24}$ (mm)				
	West Coast				East Coast
(minute)	≤ 100	120	150	≥ 180	All
5	2.08	1.85	1.62	1.40	1.39
10	1.28	1.13	0.99	0.86	1.03
15	0.80	0.72	0.62	0.54	0.74
20	0.47	0.42	0.36	0.32	0.48
30	0.00	0.00	0.00	0.00	0.00

Table Q3 (b) / *Jadual S3(b)*

Catchment	A	B	C	D	E	F
Area (acres)	10	15	20	50	12	30
Runoff coefficient	0.8	0.7	0.6	0.5	0.9	0.7
Time of flow to inlet (min)	5	7	8	15	5	10

(Note : 1 acre = 4046.86 m^2 ; 1 hectare = 10 000 m^2)

APPENDIX III

FINAL EXAMINATION

SEMESTER / SESSION	: SEM II / 2012/2013	PROGRAMME	: 4 BFF
COURSE NAME	: URBAN STORMWATER MANAGEMENT	COURSE CODE	: BFW 4053 / BFW 40503

FIGURE / *RAJAH*

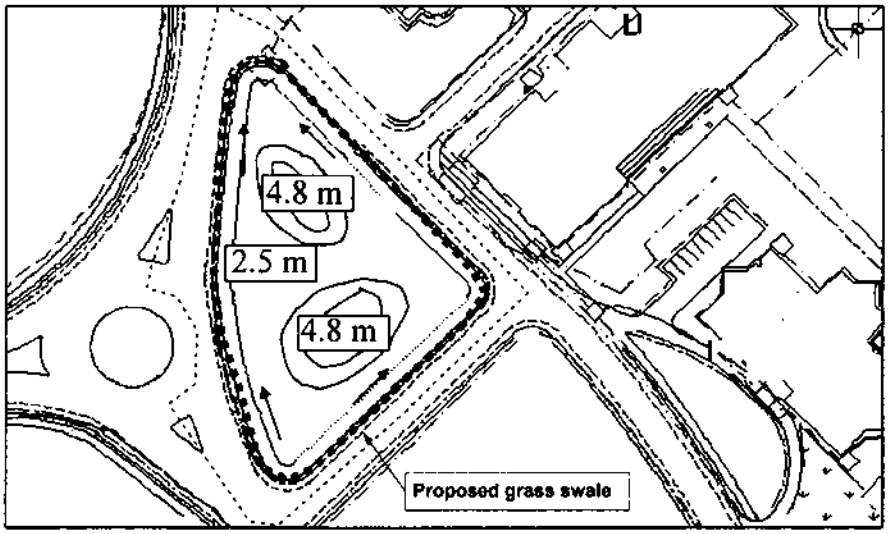

Figure Q1 (a) : Proposed developed area
Rajah S1 (a) : Cadangan keluasan pembangunan

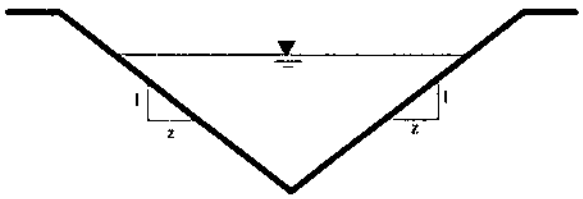

Figure Q1 (b) : Proposed 'Vee' shaped grassed swale
Rajah S1 (b) : Cadagan saluran berumput berbentuk 'Vee'

APPENDIX IV

FINAL EXAMINATION

SEMESTER / SESSION	: SEM II / 2012/2013	PROGRAMME	: 4 BFF
COURSE NAME	: URBAN STORMWATER MANAGEMENT	COURSE CODE	: BFW 4053 / BFW 40503

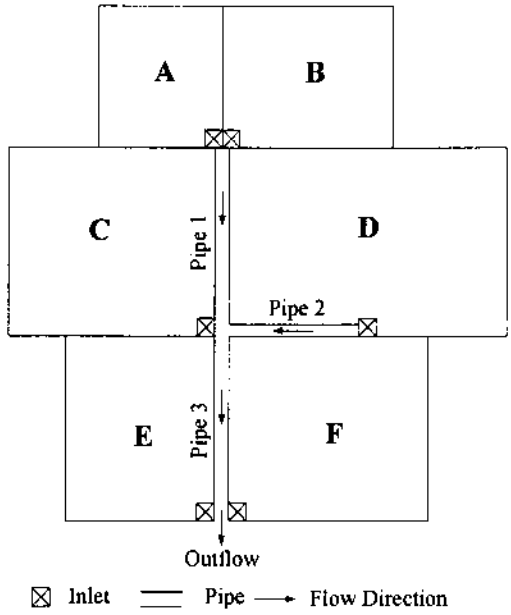

Figure Q3(b) / *Jadual S3(b)*

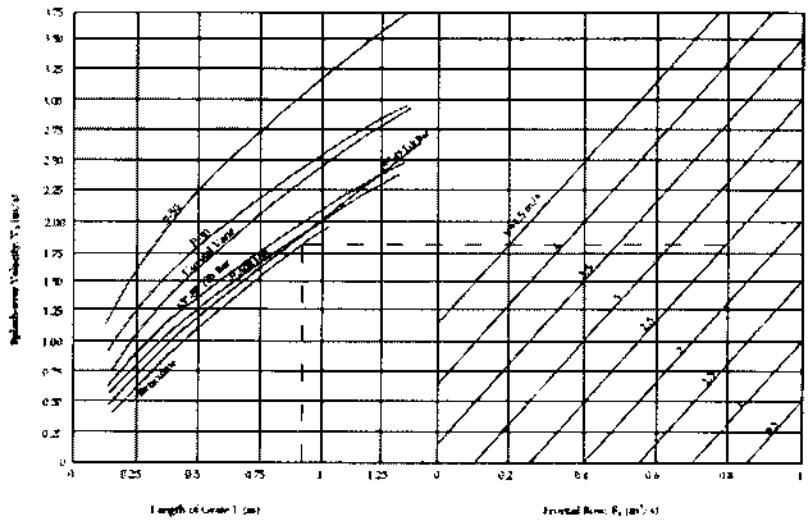

Figure Q5 (a) / *Rajah S5 (a)*

APPENDIX V

FINAL EXAMINATION

SEMESTER / SESSION	: SEM II / 2012/2013	PROGRAMME	: 4 BFF
COURSE NAME	: URBAN STORMWATER MANAGEMENT	COURSE CODE	: BFW 4053 / BFW 40503

EQUATIONS / *PERSAMAAN-PERSAMAAN*

$$Q_y = \frac{C^y I_t A}{360} \qquad P_D = P_{30} - F_D\left[P_{60} - P_{30}\right]$$

$$\ln\left({}^R I_t\right) = a + b(\ln t) + c(\ln t)^2 + d(\ln t)^3$$

$$Q_w = Q\left[1 - \left(1 - \frac{W}{T}\right)^{2.67}\right] \qquad A = \frac{1}{2} S_x T^2 \qquad V = Q / A$$

$$Q_s = Q - Q_w \qquad R_f = 1 - K_a(V - V_o)$$

$$R_s = 1/(1 + \frac{K_n V^{1.8}}{S_x L^{2.3}}) \qquad E = R_f \frac{Q_w}{Q} + R_s \frac{Q_s}{Q}$$

$$Q_t = EQ \qquad Q_b = Q - Q_t \qquad R = bD/(2b + 2D)$$

$$\frac{Hw}{D} = \frac{3}{2D}\left(\frac{Q^2}{gb^2}\right)^{1/3} + K_1\left(\frac{Q}{AD^{0.5} g^{0.5}}\right)^{M_1} + k_s S \quad \text{for box culvert inlet control}$$

$$HW = TW - SL + \left(1 + k_e + \frac{2gn^2 L}{k_n^2 R^{4/3}}\right)\frac{Q^2}{2gA^2} \quad \text{for box culvert outlet control}$$