UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	WATER RESOURCES ENGINEERING
COURSE CODE	:	BFW 4013 / BFW 40103
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTIONS	:	ANSWER **FIVE (5)** FROM SIX (6) QUESTIONS

THIS QUESTION PAPER CONSISTS OF **THIRTEEN** PAGES

Q1 (a) There are two initiatives that have been applied and implemented by the government to protect water resources as well as to improve water resources management. Explain clearly those two initiatives with appropriate examples.

(6 marks)

(b) Provide **FOUR (4)** purposes of stream flow measurement.

(4 marks)

(c) A detention pond has an area of 2.45 ha received an inflow from nearby river 0.0037 m^3/s. Excess water will be pump out with the rate of 0.0024 m^3/s. Determine the evaporation loss (in cm) for a month if a total precipitation and storage increase are 4.56 cm and 0.0025 ha-m respectively. (Assume 1 month = 31 days)

(6 marks)

(d) 15-year ARI was used as design criteria in designing detention pond. Estimate the probability that the annual maximum discharge will exceed 1250 cfs at least once during the next five years.

(4 marks)

Q2 (a) Explain in detail **FOUR (4)** types of flood management measures available in the Integrated Floodplain Management (IFM).

(8 marks)

(b) Provide the main causes of monsoonal flood and discuss how the effect of monsoonal flood can be minimized.

(4 marks)

(c) A 120-ha catchment area has the time-area relationship and the rainfall-excess distribution as shown in **Table Q2.** Estimate the runoff in m^3/s using time-area method.

(8 marks)

Q3 (a) Explain clearly **TWO (2)** natural factors and **TWO (2)** anthropogenic factors that influence surface runoff.

(8 marks)

(b) On-site detention (OSD) is to be constructed in UTHM campus area with an area of 0.34 ha and having a terrain slope of 1:2500. 65% of it shall be occupied by building, access road and pavement while 35% by garden and turf areas. By referring to **Table Q3 (i-iv)** and **Figure Q3**, calculate the Permissible Site Discharge (PSD), Site Storage Requirement (SSR) and the inlet and outlet pipe sizes.

(12 marks)

Q4 (a) List **FOUR (4)** uses of dam.

(4 marks)

(b) Provide **FOUR (4)** functions of spillway.

(4 marks)

(c) Explain **TWO (2)** types of dam failure due to spillway design.

(4 marks)

(d) Explain clearly **FOUR (4)** causes of dam failure due to geological factors and provide the solution for each cause.

(8 marks)

Q5 (a) Discuss the similarities and differences between the Muskingum and Muskingum-Cunge routing methods.

(5 marks)

(b) A triangular channel having, $S_o = 0.001$, $e = 0.343$ ft$^{1/3}$/s, $m = 4/3$ and length, L = 1000 ft. The upstream inflow hydrograph is tabulated in **Table Q5.** Calculate

(i) The downstream (outflow) hydrograph using a time increment of $\Delta t = 0.25$ hr and a baseflow of 60 cfs using Muskingum-Cunge method,

(ii) The storage from beginning to the peak time if available, and

(iii) Sketch the hydrograph

(15 marks)

Q6 (a) Explain briefly the effect of sources of water on crop production.

(i) Surface water

(ii) Groundwater

(6 marks)

(b) An irrigation system is designed using a 10-year return period. According to the Bernoulli process, determine

(i) the probability that the irrigation system capacity will be exceeded for the first time in the fifth year after the system is constructed.

(ii) the probability that the system capacity will be exceeded within the first 5 years.

(8 marks)

(c) Management, water, soil, and crops are major elements of Irrigation Water Management (IWM). Discuss all four elements.

(6 marks)

- END OF QUESTIONS -

S1 (a) Dua inisiatif telah digunapakai dan dilaksanakan oleh kerajaan untuk melindungi sumber air serta meningkatkan pengurusan sumber air di negara ini. Terangkan dengan jelas kedua-dua inisiatif tersebut beserta dengan contoh yang sesuai.

(6 markah)

(b) Nyatakan **EMPAT (4)** tujuan pengukuran aliran sungai.

(4 markah)

(c) Sebuah kolam tahanan dengan keluasan 2.45 ha menerima aliran masuk dari sungai sebanyak 0.0037 m^3/s. Air lebihan akan dipam keluar dengan kadar 0.0024 m^3/s. Kira kadar penyejatan (dalam cm) jika jumlah hujan dan peningkatan simpanan ialah 4.56 cm dan 0.0025 ha-m masing-masing bagi sebulan. (Andaikan 1 bulan = 31 hari)

(6 markah)

(d) 15-year ARI telah digunakan sebagai kriteria reka bentuk sebuah kolam tadahan. Anggarkan kebarangkalian bahawa kadar alir maksimum tahunan akan melebihi 1250 ft^3/s sekurang-kurangnya sekali dalam tempoh lima tahun akan dating.

(4 markah)

S2 (a) Huraikan dengan terperinci **EMPAT (4)** jenis langkah pengurusan banjir yang terdapat dalam Pengurusan Dataran Banjir Bersepadu (IFM).

(8 markah)

(b) Provide the main causes of monsoonal flood and discuss how the effect of monsoonal flood can be minimized.Setiap tahun negeri di pantai timur Semenanjung Malaysia sering dilanda banjir monsun.Berikan punca utama kejadian banjir monsun dan bincangkan bagaimana kesan banjir monsun dapat dikurangkan.

(4 markah)

(c) Sebuah kawasan tadahan berkeluasan 120-ha mempunyai hubungan masa-keluasan dan taburan hujan-lebihan seperti ditunjukkan dalam **Jadual S2.** Hitung kadar air larian dalam m^3/s menggunakan kaedah masa-luas.

(8 markah)

S3 (a) Huraikan secara terperinci **DUA (2)** faktor semula jadi dan **DUA (2)** faktor antropogenik yang mempengaruhi air larian permukaan.

(8 markah)

(b) Sebuah tangki tahanan (OSD) akan dibina untuk satu kawasan pembangunan seluas 0.34 ha dan berkecerunan 1:2500. 65% dari kawasan projek ini akan dibangunkan dengan fasiliti seperti bangunan, jalan dan kawasan turapan manakala 35% akan dijadikan kawasan taman, hijau dan berumput. Merujuk kepada **Jadual S3 (i-iv)** dan **Rajah S3,** kira kadar alir yang dibenarkan (PSD), keperluan simpanan di tapak (SSR), saiz paip masuk dan saiz paip keluar.

(12 markah)

S4 (a) Senaraikan **EMPAT (4)** kegunaan empangan.

(4 markah)

(b) Berikan **EMPAT (4)** fungsi alur limpah

(4 markah)

(c) Huraikan **DUA (2)** jenis kegagalan empagan yang disebabkan oleh rekabentuk alur limpah.

(4 markah)

(d) Huraikan dengan terperinci **EMPAT (4)** punca kegagalan empangan yang disebabkan oleh faktor geologi dan cadangkan langkah-langkah penyelesaian untuk setiap punca yang dinyatakan.

(8 markah)

S5 (a) Bincangkan persamaan dan perbezaan di antara kaedah penghalaan Muskingum dan Muskingum-Cunge.

(5 markah)

(b) Sebuah saluran segitiga mempunyai S_o = 0.001, e = 0.343 $ft^{1/3}/s$, m = 4/3 dan panjang, L = 1000 ft. Hidrograf aliran masuk dihulu diberi dalam **Jadual S5.** Kira

(i) hidrograf aliran keluar (hilir) menggunakan perubahan masa Δt = 0.25 jam dan dasar aliran sebanyak 60 ft^3/s menggunakan kaedah Muskingum-Cunge,

(ii) tentukan simpanan takungan dari awal hingga masa aliran puncak, sekiranya ada

(iii) Plotkan hidrograf tersebut.

(15 markah)

S6 (a) Bincangkan secara ringkas pengaruh punca sumber air berikut terhadap produktiviti tanaman

(i) Air permukaan

(ii) Air bumi

(6 markah)

(b) Satu sistem pengairan direkabentuk untuk menampung aliran dengan kala kembali 10-tahun. Berdasarkan proses Bernoulli, kira

(i) Kebarangkalian akan berlaku melebihi kapasiti untuk kali pertama pada lima tahun selepas ia dibina.

(ii) kemungkinan kapasiti sistem ini yang akan melebihi rekabentuknya dalam tempoh 5 tahun pertama.

(8 markah)

(c) Pengurusan, air, tanah dan tanaman merupakan elemen utama dalam Pengurusan Pengairan Air (IWM). Bincangkan setiap elemen tersebut.

(6 markah)

- SOALAN TAMAT -

APPENDIX I

FINAL EXAMINATION

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TABLE/JADUAL

Table Q2/Jadual S2 Time-area and rainfall-excess distribution relationship

Time (min)	Contributing area (ha)
0	0
10	12
20	35
30	48
40	82
50	108
60	120

Time (min)	Average intensity (mm/h)
0 - 10	99
10 - 20	72
20 - 30	43
30 - 40	24

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Table Q3(i)/Jadual S3 (i) Maximum Permissible Site Storage (PSD), Minimum Site Storage Requirement (SSR), and Inlet values in accordance with the major towns in Peninsular Malaysia

Terrain/Slope Condition	PSD (l/s/ha)					SSR (m^3/ha)					Inlet (l/s/ha)				
	Impervious Area (as a Percentage of Project area)														
	25%	40%	50%	75%	90%	25%	40%	50%	75%	90%	25%	40%	50%	75%	90%
Batu Pahat															
Low-lying	45.1	45.6	45.9	46.3	46.6	249.2	293.7	331.1	437.3	502.6	107.0	125.0	137.0	166.0	184.0
Mild	55.6	56.2	56.6	57.1	57.4	234.7	273.8	304.7	403.7	468.4	127.0	146.0	158.0	189.0	208.0
Steep	62.3	63.0	63.4	64.0	64.3	225.6	261.8	291.3	383.5	447.1	140.0	159.0	172.0	204.0	224.0
Johor bharu															
Low-lying	61.1	61.9	62.2	62.8	63.1	315.0	362.0	398.4	501.0	572.7	138.0	157.0	170.0	200.0	221.0
Mild	74.8	75.7	76.1	76.9	77.2	298.5	340.9	372.6	465.9	532.3	163.0	184.0	200.0	231.0	252.0
Steep	83.4	84.3	84.8	85.7	86.1	288.5	323.3	352.5	442.8	505.0	181.0	200.0	215.0	250.0	271.0
Segamat															
Low-lying	41.4	41.9	42.1	42.5	42.7	294.3	326.6	356.0	454.9	512.2	110.0	130.0	140.0	170.0	190.0
Mild	48.6	49.1	49.4	49.9	50.1	289.2	321.1	350.0	431.6	497.4	140.0	150.0	170.0	200.0	220.0
Steep	54.2	54.8	55.1	55.7	55.9	280.2	310.5	332.9	415.1	479.1	150.0	170.0	180.0	220.0	240.0

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Table Q3 (ii)/ Jadual S3 (ii) Maximum Permissible Site Storage (PSD)and Minimum Site Storage Requirement (SSR) in accordance with the five regions in Peninsular Malaysia

Terrain/Slope Condition	PSD (l/s/ha)					SSR (m^3/ha)				
	Impervious Area (as a Percentage of Project area)									
	25%	40%	50%	75%	90%	25%	40%	50%	75%	90%
Region 1 – West Coast										
Low-lying	63.4	64.2	64.5	65.2	65.5	322.2	363.0	394.2	478.3	540.4
Mild	76.7	77.5	77.9	78.7	79.1	306.6	340.0	367.2	448.5	504.7
Steep	87.7	88.6	89.1	90.1	90.5	294.0	327.0	350.5	426.7	478.8
Region 2 – East Coast										
Low-lying	53.0	53.6	53.9	54.5	54.7	276.6	350.4	410.7	609.1	768.8
Mild	61.1	61.8	62.2	62.8	63.1	257.6	321.7	373.9	546.1	678.7
Steep	67.4	68.2	68.6	69.3	69.6	243.5	302.6	351.0	509.9	625.9
Region 3 – Northern										
Low-lying	54.8	55.4	55.7	56.3	56.5	311.1	353.3	389.7	493.3	564.4
Mild	68.0	68.8	69.2	69.9	70.2	295.5	328.3	360.3	454.0	521.6
Steep	77.3	78.2	78.6	79.5	79.8	284.8	316.2	341.8	430.3	492.6
Region 4 – Highland										
Low-lying	42.6	43.1	43.4	43.8	44.0	227.8	285.7	331.4	460.5	546.6
Mild	49.6	50.2	50.5	51.0	51.2	212.3	266.0	307.3	428.2	509.2
Steep	55.0	55.6	56.0	56.5	56.8	202.1	252.3	291.0	405.5	484.1
Region 5 – Southern										
Low-lying	61.1	61.9	62.2	62.8	63.1	315.0	362.0	398.4	501.0	572.7
Mild	74.8	75.7	76.1	76.9	77.2	298.5	340.9	372.6	465.9	532.3
Steep	83.4	84.3	84.8	85.7	86.1	288.5	323.3	352.5	442.8	505.0

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Table Q3(iii)/ Jadual S3 (iii) OSD volume, Inlet and Outlet size for Region 5

Project Area (ha)	Impervious Area (as a Percentage of Project area)														
	25%			40%			50%			75%			90%		
	Volume (m3)	Inlet & overflow Dia. (mm)	Outlet dia. (mm)	Volume (m3)	Inlet & overflow Dia. (mm)	Outlet dia. (mm)	Volume (m3)	Inlet & overflow Dia. (mm)	Outlet dia. (mm)	Volume (m3)	Inlet & overflow Dia. (mm)	Outlet dia. (mm)	Volume (m3)	Inlet & overflow Dia. (mm)	Outlet dia. (mm)
TERRAIN: LOWLYING, SLOPE 1:2000 to 1:5000															
0.1	32	133	61	37	141	62	40	147	62	50	1600	62	58	168	62
0.2	63	188	86	73	200	87	80	208	87	96	226	87	115	237	87
0.4	126	265	122	146	283	124	160	294	124	192	319	124	230	336	124
0.6	189	325	149	219	346	151	240	355	151	288	391	151	345	411	151
0.8	252	375	172	292	400	175	320	416	175	384	451	175	460	475	175
1	315	419	192	365	447	195	400	465	195	500	507	195	575	531	195
2	750	443	272	880	484	276	970	510	276	1260	569	276	1460	604	276
3	1125	542	333	1320	593	339	1455	624	339	1890	697	339	2190	739	339
4	1500	626	384	1760	685	391	1940	721	391	2520	804	391	2920	854	391
5	1875	700	430	2200	765	437	2425	806	437	3150	899	437	3650	954	437
TERRAIN: MILD, SLOPE 1:875 to 1:1999															
0.1	30	144	68	35	153	68	38	158	68	47	172	69	54	179	69
0.2	60	204	96	69	217	96	75	224	96	93	243	97	107	253	97
0.4	120	288	135	138	306	135	150	317	135	186	343	137	214	358	137
0.6	180	353	166	207	375	166	225	388	166	279	420	168	321	439	168
0.8	240	408	192	276	433	192	300	448	192	372	485	194	428	507	194
1	300	456	214	345	484	214	375	501	214	465	542	217	535	567	217
2	740	482	303	850	522	303	940	546	303	1220	606	307	1420	638	307
3	1110	590	371	1275	639	371	1410	669	371	1830	742	376	2130	782	376
4	1480	681	428	1700	738	428	1880	772	428	2440	857	434	2840	903	434
5	1850	761	479	2125	826	479	2350	863	479	3050	958	485	3550	1010	485
TERRAIN: STEEP, SLOPE 1:100 to 1:874															
0.1	30	152	71	32.5	160	71	35	165	72	44.5	178	72	50.5	186	72
0.2	59	215	101	65	227	101	70	234	102	89	252	102	101	263	102
0.4	118	304	143	130	321	143	140	331	145	178	357	145	202	372	145
0.6	177	372	175	195	393	175	210	405	177	267	437	177	303	455	177
0.8	236	429	202	260	454	202	280	468	204	356	505	204	404	526	204
1	300	480	226	320	507	226	290	523	229	405	564	229	485	588	229

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Table Q3 (iv)/ Jadual S3 (iv) Discharge and Pipe Diameter Relationship

Terrain: Low-lying		Terrain: Mild		Terrain: Steep	
Discharge (m^3/s)	Pipe Diameter (mm)	Discharge (m^3/s)	Pipe Diameter (mm)	Discharge (m^3/s)	Pipe Diameter (mm)
0.01	236	0.01	250	0.01	259
0.02	247	0.02	261	0.02	269
0.04	270	0.04	282	0.04	288
0.06	292	0.06	303	0.06	307
0.08	315	0.08	325	0.08	326
0.1	338	0.1	346	0.1	345
0.12	361	0.12	367	0.12	364
0.16	406	0.16	410	0.16	402
0.22	474	0.22	474	0.22	459
0.24	497	0.24	495	0.24	478
0.28	542	0.28	538	0.28	516
0.32	587	0.32	581	0.32	554
0.36	633	0.36	623	0.36	592
0.42	701	0.42	687	0.42	649
0.48	769	0.48	751	0.48	707
0.52	814	0.52	794	0.52	745
0.56	860	0.56	836	0.56	783
0.62	928	0.62	900	0.62	840
0.66	973	0.66	943	0.66	878
0.72	1041	0.72	1007	0.72	935
0.78	1109	0.78	1071	0.78	992
0.82	1154	0.82	1114	0.82	1030

APPENDIX VI

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Table Q5/ Jadual S5 Relationship between Time and Inflow (cfs)

Time step	Time (hr)	Inflow (cfs)
1	0.00	10
2	0.25	16
3	0.50	31
4	0.75	50
5	1.00	58
6	1.25	60
7	1.50	54
8	1.75	42
9	2.00	32
10	2.25	25
11	2.50	20
12	2.75	17
13	3.00	15
14	3.25	13
15	3.50	12
16	3.75	11
17	4.00	10
18	4.25	10
19	4.50	10
20	4.75	10

APPENDIX VII

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FIGURE/ RAJAH

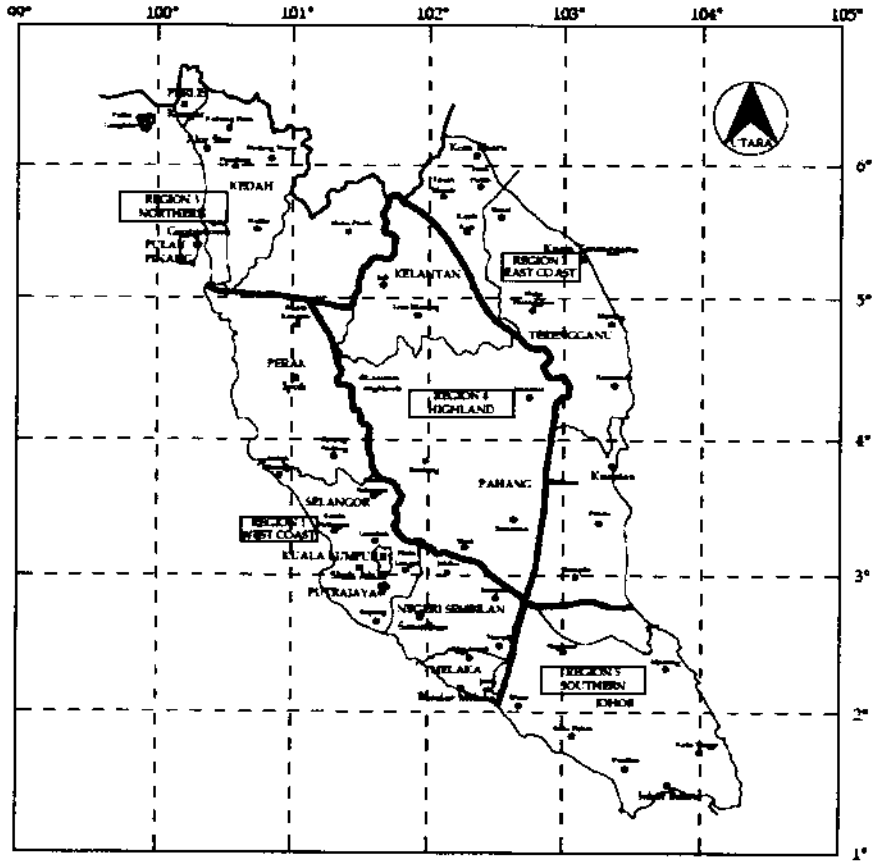

Figure Q3/ Rajah S3 Five (5) Design Regions

EQUATIONS/PERSAMAAN

$$A_o = \left(\frac{Q_o}{e}\right)^{3/4} \qquad y_o = \left(\frac{A_o}{5}\right)^{1/2} \qquad T_o = 10y_o \qquad V_o = \frac{Q_o}{A_o} \qquad K = \frac{L}{mV_o}$$

$$X = 0.5\left(1 - \frac{Q_o / T_o}{S_o m V_o L}\right) \qquad Q_2 = C_0 I_2 + C_1 I_1 + C_2 Q_1$$

$$C_0 = \frac{(\Delta t / K) - 2X}{2(1-X) + (\Delta t / K)} \qquad C_1 = \frac{(\Delta t / K) + 2X}{2(1-X) + (\Delta t / K)} \qquad C_2 = \frac{2(1-X) - (\Delta t / K)}{2(1-X) + (\Delta t / K)}$$

$$P = \sum_{n=1}^{5} p(1-p)^{n-1} \qquad P(Q > X) = \frac{1}{T}$$