UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	URBAN STORMWATER MANAGEMENT
COURSE CODE	:	BNA 40703
PROGRAMME	:	BNA
DATE	:	DECEMBER 2016/JANUARY 2017
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN SECTION A B) ANSWER **FOUR (4)** QUESTIONS IN SECTION B

TERBUKA

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

SECTION A

Q1 (a) The responsibility for urban stormwater management is shared between Malaysian Federal and State agencies/institution. List **FOUR (4)** roles and responsibilities for each of Federal and State agencies.

(8 marks)

(b) Upon approval for any Malaysian project development, a complete process of submission procedure based on authority requirement is needed.

i) List all the requirements needed, and;

ii) Briefly discuss the first **THREE (3)** steps of the process, provide the flowchart if needed.

(12 marks)

SECTION B

Q2 (a) List:

i) **TWO (2)** factors that need to be considered in choosing the average recurrence interval (ARI).

ii) **TWO (2)** objectives of major and minor system design.

(5 marks)

(b) An annual maximum series of 30 years for a 20 minutes rainfall depths is given in Table **Q2(i)**, compute the following:

i) Average of annual maximum depth, P_{TM}

ii) Varians of annual maximum depth, s

(8 marks)

(c) Assuming extreme value type I distribution fits the 30 year annual maximum series, predict the 20 minutes storm and its rainfall intensity where the average intensities are associated with a 40 year ARI that could cater for a road culvert design according to annual maximum series in Table **Q2(ii)**.

(7 marks)

Q3 (a) Briefly explain the procedure for estimating peak flow using the rational method.

(6 marks)

(b) An urban catchment with 58 hectares of commercial area in Bandar Maharani, Muar Johor is shown in Figure **Q3**. By using the method from MSMA 2nd edition, calculate the intensity using empirical method and plot the temporal pattern of design rainfall for 15 minutes for this catchment with return period of 10-years ARI.

(7 marks)

(c) Using time-area method, predict the peak discharge of the hydrograph if the design rainfall event calculated from **Q3(b)** occurs in this catchment. Assume continuous loss is constant at 0.8 mm/5min. Plot the hydrograph.

(7 marks)

Q4 (a) Briefly explain the purpose of detention facilities.

(3 marks)

(b) List down **FIVE (5)** benefits of detention facilities for stormwater management.

(5 marks)

(c) Compare **TWO (2)** differences of the functions between detention and retention ponds from engineering purposes.

(4 marks)

(d) A wet extended detention pond sized for the required water quality volume will be used to illustrate the sizing procedure for an extended-detention orifice. Given the following information, calculate the required orifice size for water quality design. Given: water quality volume, $WQv = 920.66\ m^3$, maximum hydraulic head, $H_{max} = 1.615$ m (from stage vs. storage data), $C = 0.66$ and $Q = CA(2gH)^{0.5}$.

(8 marks)

Q5 (a) Identify the major inlet types as shown in Figure **Q5(i)** by labeling the names of these structures respectively.

(2 marks)

(b) A triangular gutter has a longitudinal slope of $S_L = 0.02$, cross slope of $S_x = 0.03$, and Manning roughness of $n = 0.0099$. Determine the flow depth and spread at a discharge of 0.486 m^2/s. Given that $k_n = 1.0\ m^{1/3}/s$.

(6 marks)

(c) A composite gutter section has the dimension of $W = 1$ m, $S_L = 0.08$, $S_x = 0.03$, and a = 0.09 m. The Manning roughness factor is $n = 0.099$. Estimate the discharge in the gutter at a spread, T = 2.5 m and $k_n = 1.0$ $m^{1/3}/s$.

(6 marks)

(d) A V-shape swale often has left and right side slopes that are equal. Explain on how the flow rate and depth would change if the both side slopes were changed to 0.05. Given that $n = 0.099$, $S_L = 0.01$, T = 2.55 m and $k_n = 1.0\ m^{1/3}/s$. Sketch the cross section of this swale with the particular dimensions.

(6 marks)

Q6 (a) Identify **FOUR (4)** pollutants that are likely to be found in urban stormwater and probable source of the pollutants.

(4 marks)

(b) "*Vegetative practices are usually employed in conjunction with other BMPs , since the vegetative practices alone do not have the capability of entirely controlling the increased runoff and pollutant export from a site*". Briefly appraise this statement regarding the stormwater management practices and its application.

(5 marks)

(c) A sand filter BMP will be designed to treat the first 0.0127 m of runoff per impervious m^2 from a 60,702.85 m^2 commercial site, which is 85 % impervious. Determine the dimensions of the sand bed using K = 1.07 m/day, T_d = 40 hr = 1.67 days, and Z = 0.46 m. The sedimentation basin will be sized to release the water quality volume over a 24 hr period.

(5 marks)

(d) Briefly discuss your opinion of **THREE (3)** actions on principles of Erosion and Sediment Control (ESC) to handle the problems according to site conditions.

(6 marks)

-END OF QUESTIONS-

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FIGURES

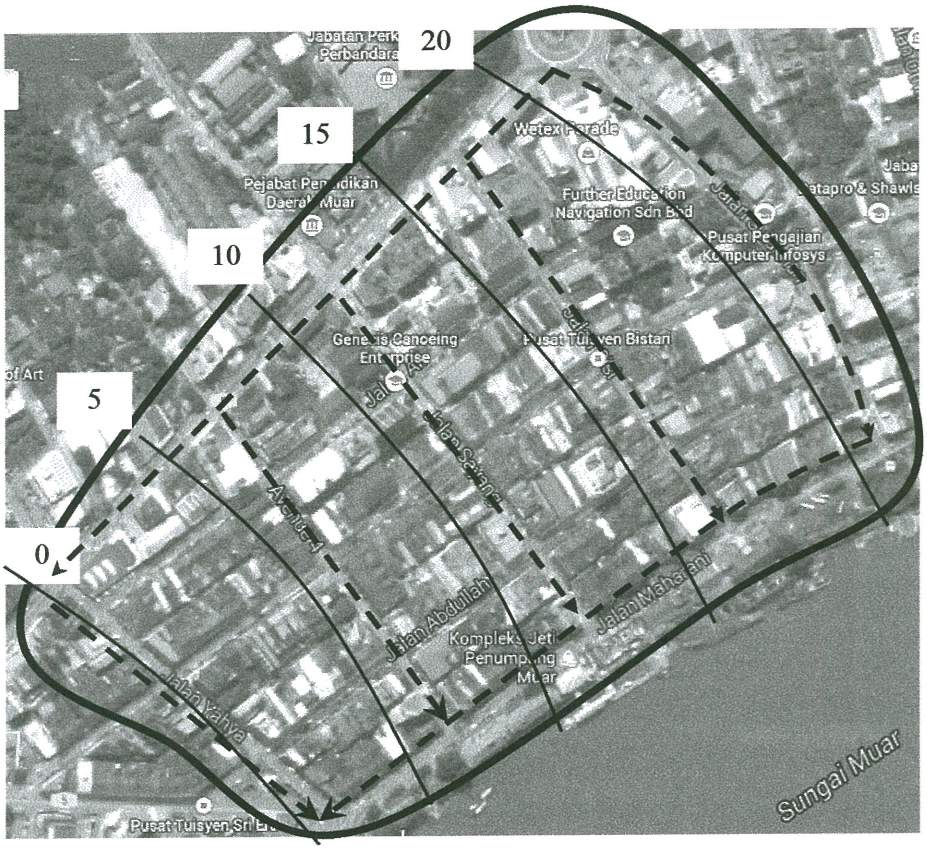

Figure Q3

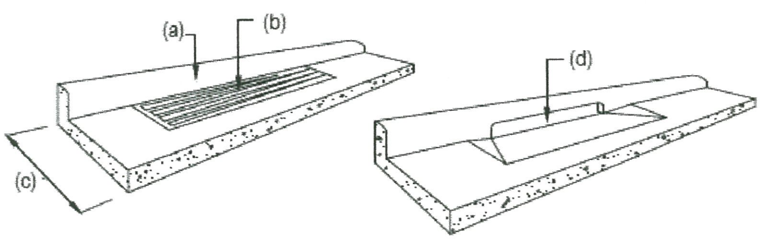

Figure Q5(i)

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FIGURES

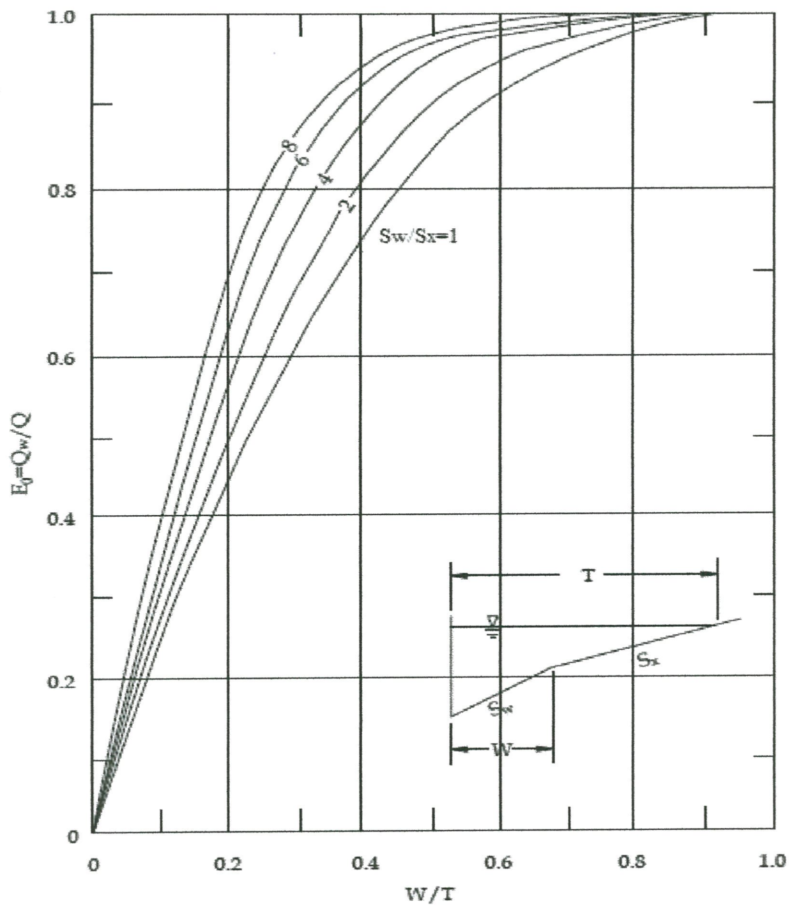

Figure Q5(ii)

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EQUATIONS

$$P_{TM} = \frac{\Sigma P_j}{n} \qquad s = \sqrt{\frac{\Sigma(P_j - P_{TM})^2}{n-1}} \qquad P_T = P_{TM} + Ks \qquad I = \frac{P_T}{t_d}$$

$$i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}} \qquad WQV = C.(P_d).A \qquad Q = \frac{k_n T^{8/3} S_x^{5/3} S_L^{1/2}}{2.64n}$$

$$y = S_x T \qquad S_w = S_x + \frac{a}{W} \qquad T_s = T - W \qquad Q = \frac{Q_s}{1-E_o} \qquad S_x = \frac{S_{x1} S_{x2}}{S_{x1} + S_{x2}}$$

$$A_{sb} = \frac{S_Q Z}{K(h_{avg} + Z)T_d} \qquad S_Q = nLWd_t$$

TABLES

Table Q2(i): 15 minutes rainfall depth

P_j (mm)	3.55	3.81	4.32	4.44	4.73	5.11	5.82
	6.84	7.33	7.85	8.88	9.55	10.20	11.26

Table Q2(ii): Frequency factor, K for extreme value type I

	T_r (years)				
n	**5**	**10**	**25**	**50**	**100**
15	0.967	1.703	2.632	3.321	4.005
20	0.919	1.625	2.517	3.179	3.836
25	0.888	1.575	2.444	3.088	3.729
30	0.866	1.541	2.393	3.026	3.653
35	0.851	1.516	2.354	2.979	3.598
40	0.838	1.495	2.326	2.943	3.554
45	0.829	1.478	2.303	2.913	3.520
50	0.820	1.466	2.283	2.889	3.491
75	0.792	1.423	2.220	2.812	3.400
100	0.779	1.401	2.187	2.770	3.349
∞	0.719	1.305	2.044	2.592	3.137

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TABLES

Table Q3(i): Fitting constants for the IDF empirical equation for the different location in Malaysia for high ARIs between 2 and 100 year and storm duration from 5 minutes to 72 hours

State	No	Station ID	Station Name	Constant			
				λ	κ	θ	η
Johor	1	1437116	Stor JPS Johor Bahru	59.972	0.163	0.121	0.793
	2	1534002	Pintu Kawasan Tanjung Agas	80.936	0.187	0.258	0.890
	3	1541139	Ladang Labis	45.808	0.222	0.012	0.713
Kuala Lumpur	1	3015001	Puchong Drop, K Lumpur	69.650	0.151	0.223	0.880
	2	3116003	Ibu Pejabat JPS	61.976	0.145	0.122	0.818
	3	3116004	Ibu Pejabat JPS1	64.689	0.149	0.174	0.837

Table Q3(ii): Recommended Intervals for Design Rainfall Temporal Pattern

Storm Duration (minutes)	Time Interval (minutes)
Less than 60	5
60 – 120	10
121 – 360	15
Greater than 360	30

Table Q3(iii): Region 2: Johor, Negeri Sembilan, Melaka, Selangor dan Pahang

No. of Block	Storm Duration			
	15-min	30-min	60-min	180-min
1	0.255	0.124	0.053	0.053
2	0.376	0.130	0.059	0.061
3	0.370	0.365	0.063	0.063
4		0.152	0.087	0.080
5		0.126	0.103	0.128
6		0.103	0.153	0.151
7			0.110	0.129
8			0.088	0.097
9			0.069	0.079
10			0.060	0.062
11			0.057	0.054
12			0.046	0.042

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Table Q3(iv): Areas between the isochrones

ID	Isochrones	Area (ha)
A_1	0 – 5	18
A_2	5 – 10	10
A_3	10 – 15	12
A_4	15 >	18