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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	URBAN STORMWATER MANAGEMENT
COURSE CODE	:	BFW 40503
PROGRAMME	:	BFF
DATE	:	JUNE / JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

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

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

(8 marks)

(b) Describe major and minor stormwater systems and illustrate the components with aided sketch of design criteria in stormwater system.

(12 marks)

Q2 (a) Describe time of concentration and formulate based on design of stormwater drainage system.

(5 marks)

(b) Discuss with aided sketch of the design procedure in developing:
(i) IDF curves
(ii) Rational Method Estimation

(8 marks)

(c) Compute the rainfall intensity for 3 hours storm duration with 2 years ARI for area 60 km^2 Ladang Lendu, Melacca using empirical method. Refer to **TABLE Q2 (c)** and **FIGURE Q2 (c)**.

(7 marks)

Q3 (a) Calculate the intensity using empirical equation and plot the temporal pattern of design rainfall for 15 minutes for this catchment with return period of 5-years ARI. An urban catchment with 45 hectares of commercial area in Bandar Maharani, Muar Johor is shown in **FIGURE Q3 (a)**.

(10 marks)

(b) Predict the peak discharge using time-area method of the hydrograph if the design rainfall event calculated from **Q3 (a)** occurs in this catchment. Assume continuous loss is constant at 0.2 mm/5 min. Plot the hydrograph.

(10 marks)

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Q4 (a) List **THREE (3)** types of retention facilities for stormwater management practice.

(3 marks)

(b) Differentiate between both terms as follows, and explain the similarity of their structure's function.
(i) Embankment Structures
(ii)Excavated Structures

(5 marks)

(c) Identify by labeling **FIGURE Q4 (c)** particularly based on onsite detention (OSD) concept.

(4 marks)

(d) Propose the suitable outlet structures to these facilities as shown in **FIGURE Q4 (d)** and give **TWO (2)** reasons for different design purpose and application.

(8 marks)

Q5 (a) Determine the bypass flow the curved vane grate inlet ($W = 1.5$m and $L = 1.0$m) located in a triangular gutter if $S_x = 0.02$, $S_L = 0.01$ and $T = 2.5$m carries $Q = 0.85$ m^3/s. Show the efficiency of this grate. How long would the curve vane grate need to be to intercept 75% of the gutter flow. Given $K_u = 0.0556$.

(10 marks)

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

(10 marks)

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

(2 marks)

(b)   List out the Best Management Practice (BMPs) categories. Provide **TWO (2)** examples (facilities) that effectively practiced to control stormwater quality.

(6 marks)

(c)   *"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)

(d)   Describe clearly with the aid of sketches the erosion and sedimentation process.
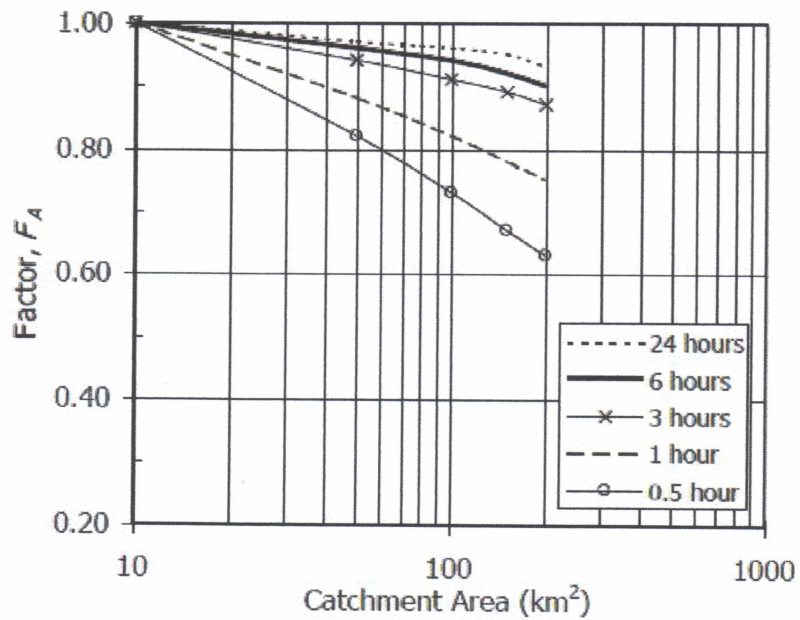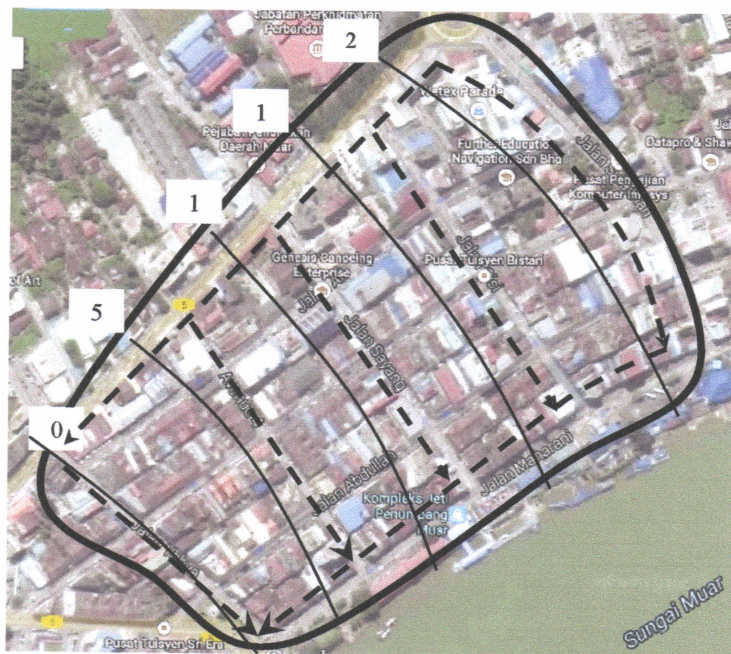
(7 marks)

-END OF QUESTIONS-

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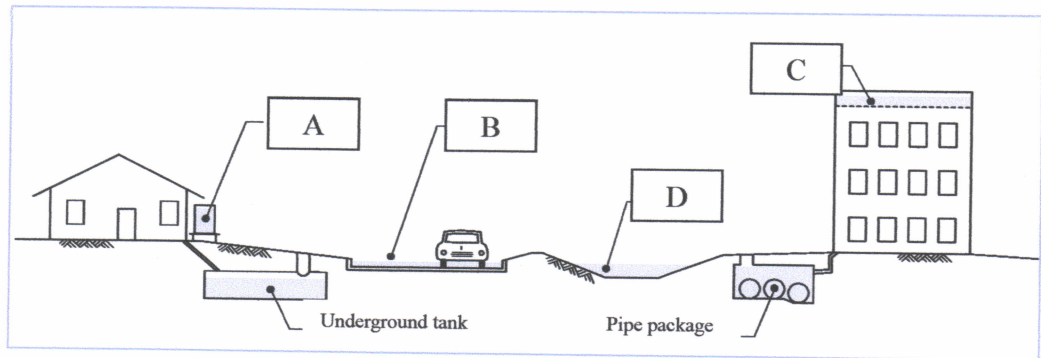
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FIGURES

FIGURE Q2(c): Areal reduction factor

FIGURE Q3(b) : Bandar Maharani, Muar

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FIGURES

Underground tank   Pipe package

FIGURE Q4 (c) : On-site detention facilities

(a)

(c)

(b)

(d)
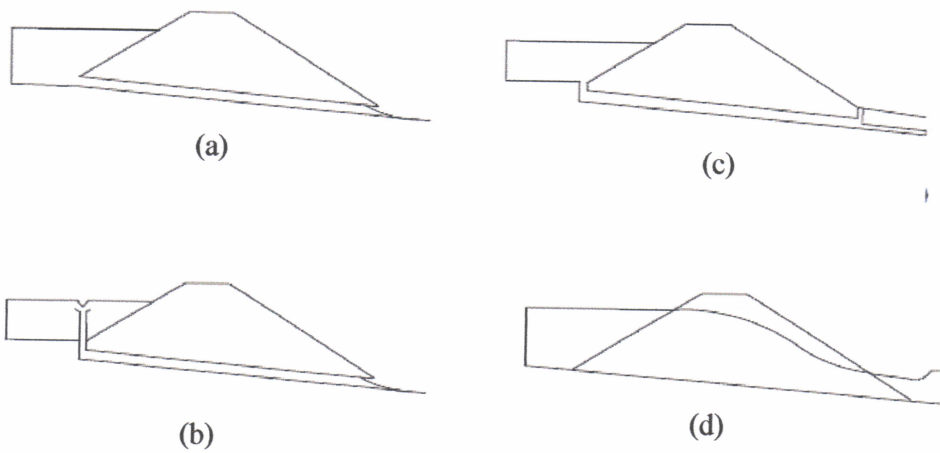
FIGURE Q4 (d) : Type of culverts

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FIGURES

FIGURE Q5(a) : Design chart

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TABLES

TABLE Q2(c) and Q3(a) : Fitting constants for the IDF empirical equation

State	No	Station ID	Station Name	Constant			
				λ	κ	θ	η
Melacca	1	2222001	Bukit Sebukor	78.1482	0.2690	0.3677	0.8968
	2	2224038	Chin Chin Tepi Jalan	66.0589	0.3363	0.3301	0.8905
	3	2321006	Ladang Lendu	64.7588	0.2975	0.2896	0.8787
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

TABLE Q3(a): 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(a): Region 2: Johor, Negeri Sembilan, Melaka, Selangor and Pahang

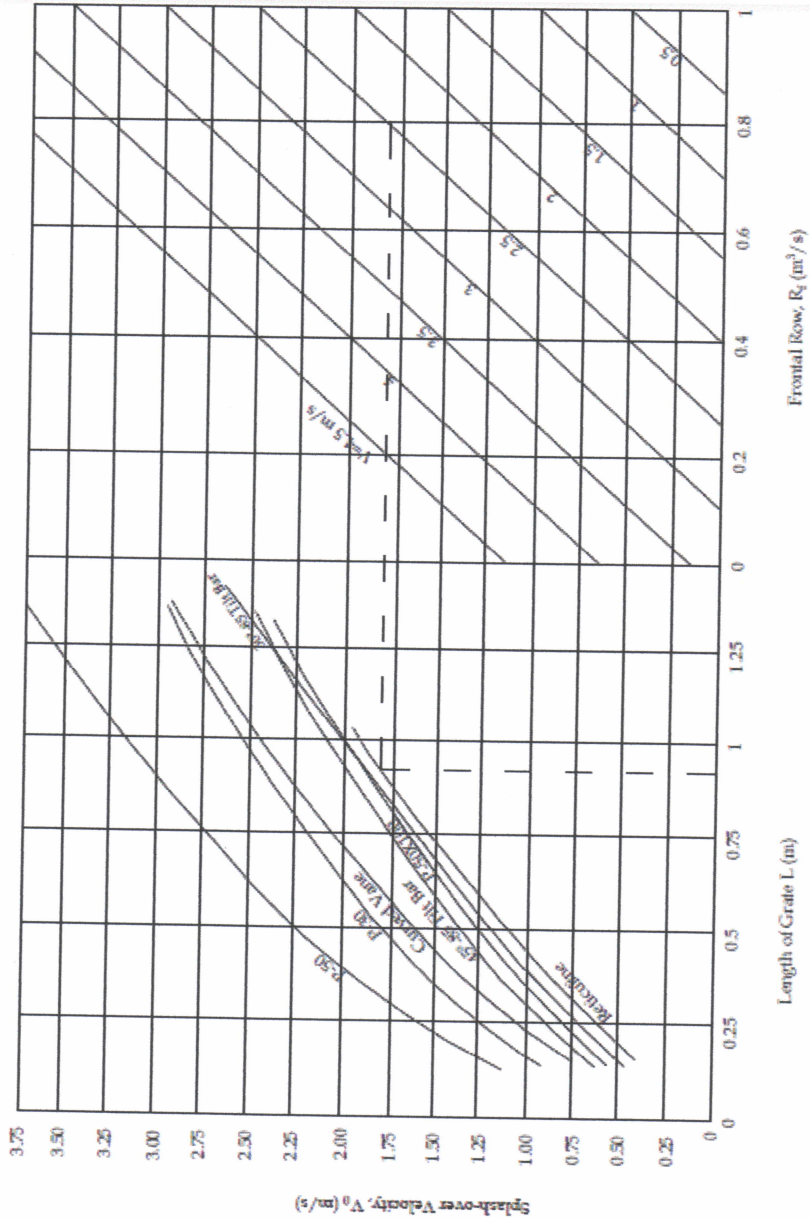| No. of Block	Storm Duration			
	15-min	30-min	60-min	180-min
1	0.255	0.124	0.053	0.053
2	0.376	0.130	0.059	0.061
3	0.370	0.365	0.063	0.063
4		0.152	0.087	0.080
5		0.126	0.103	0.128
6		0.103	0.153	0.151
7			0.110	0.129
8			0.088	0.097
9			0.069	0.079
10			0.060	0.062
11			0.057	0.054
12			0.046	0.042

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TABLE Q3(b): Areas between the isochrones

ID	Isochrones	Area (ha)
A_1	$0-5$	15
A_2	$5-10$	10
A_3	$10-15$	10
A_4	$15 >$	10

EQUATIONS

$$i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}} \qquad i = F_A(i) \qquad A = \frac{1}{2} S_x T^2$$

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

$$R_f = 1 - K_u(V - V_o) \qquad R_s = 1/(1 + \frac{K_u V^{1.8}}{S_x L^{2.3}})$$

$$E = R_f \frac{Q_w}{Q} + R_s \frac{Q_s}{Q} \qquad Q_i = EQ \qquad Q_b = Q - Q_i$$

$$\left(\frac{Q}{AD^{1/2} g^{1/2}}\right) = culvert\ \ condition$$

$$\frac{Hw}{D} = \frac{3}{2D}\left(\frac{Q^2}{gb^2}\right)^{1/3} + K_I\left(\frac{Q}{AD^{0.5} g^{0.5}}\right)^{M_I} + k_s S$$

$$R = bD/(2b + 2D)$$

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

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