UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	URBAN STORMWATER MANAGEMENT
COURSE CODE	:	BFW 40503
PROGRAMME	:	4 BFF
DATE	:	JUNE 2014
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	A) ANSWER **ALL** QUESTION IN SECTION A B) ANSWER **FOUR (4)** QUESTIONS ONLY IN SECTION B

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

SECTION A

Q1 (a) Define stormwater management and list **THREE (3)** hydraulic structures for runoff conveyance.

(4 marks)

(b) List **TWO (2)** stormwater system categories. With the aid of illustrations, explain in brief the roles of these systems.

(4 marks)

(c) In planning and designing facilities for stormwater management system for urban development, there are **TWO (2)** main design criterias that required to be followed; quantity and quality designs. Based on your opinion, discuss on why both stormwater quantity and quality facilities are needed for any urban development in Malaysia.

(6 marks)

(d) Compare the differences between storage facilities and conveyance facilities.

(6 marks)

SECTION B

Q2 (a) Explain in brief the procedure for estimating peak flow using the rational method.

(6 marks)

(b) An industry, commercial and business centre areas comprising urban sub-catchment 1 and 2 respectively as shown in Figure **Q2(b)** are to be developed in Kompleks Prai Pulau Pinang. Design the peak flow rate from minor system for the second segment at pipe cross section-y.

(8 marks)

(c) Explain why rational method that adopted in **Q2(b)** is suitable in designing peak flow rate for that area.

(6 marks)

Q3 (a) Briefly explain the purpose of detention facilities. Compare **TWO (2)** differences of the functions between the detention and retention ponds from engineering purposes.

(6 marks)

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

(6 marks)

(c) Road infrastructure in high rise housing areas in Kuala Lumpur always facing flash flood problems. As a water engineer, you are appointed to re-develop the drainage system of this area based on Manual of Urban Stormwater Malaysia. Propose at least **FOUR (4)** suitable structures in order to tackle this flash flood problem and discuss why.

(8 marks)

Q4 (a) Define:

(i) Bioretention
(ii) Filter bed area
(iii) Water quality volume
(iv) Sub-soil pipe
(v) Inlet structure
(vi) Outlet structure

(6 marks)

(b) Justify the difference between permeable bioretention system specification and impermeable bioretention system specification.

(7 marks)

(c) An industrial area located in Bukit Banang, Batu Pahat, has been adopted for the warehouse development with lot area of 1 ha (100 m × 100 m), floor area 60 m × 60 m and parking area 60 m × 20 m (**Figure Q4(c)**). The stormwater runoff from the impervious area will be directed to the vegetated filter strip around the perimeter of the building and parking areas. The distributed stormwater runoff from vegetated filter strip will be collected in the grassed swale to be conveyed downstream of the lot area and treated by a bioretention facility of impermeable type. Given that velocity V and length L of flow in the swale, overland flow time t_o and average recurrence interval ARI, are 0.25 m/s, 175 m, 5 minutes, and 5-yr respectively. Compute the water quality volume for this bioretention if rainfall depth P for this area is 45 mm for 3 month ARI.

(7 marks)

Q5 (a) Identify **FOUR (4)** pollutants that are likely to be found in urban stormwater and probable source of the pollutants.

(8 marks)

(b) Define Best Management Practice (BMPs). Provide **TWO (2)** examples of facilities that involve effectively in practice to control stormwater quality.

(5 marks)

(c) Discuss the following problems and propose the solution based on the construction sites where erosion and sediment are occur:

(i) Large flat exposed areas are prone to sheet erosion and should be protected.
(ii) Unprotected steep slopes are prone to erosion as runoff velocity is high.
(iii) Any construction works near or at streams or waterways are caused dislodged sediments to enter water directly.

(7 marks)

Q6 (a) Identify the major inlet types as shown in **Figure Q6(a)** by labeling the names of these structures A, B and C respectively.

(6 marks)

(b) A triangular gutter has a longitudinal slope of $S_L = 0.01$, cross slope of $S_x = 0.02$, and Manning roughness of $n = 0.016$. Determine the flow depth and spread at a discharge of 0.186 m^2/s. Given that $k_n = 1.0\ m^{1/3}/s$.

(7 marks)

(c) A composite gutter section has the dimension of W = 0.5 m, $S_L = 0.08$, $S_x = 0.02$, and a = 0.05 m. The Manning roughness factor is $n = 0.016$. Estimate the discharge in the gutter at a spread, T = 2.0 m and $k_n = 1.0\ m^{1/3}/s$.

(7 marks)

-END OF QUESTION-

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2013/2014 PROGRAMME : 4 BFF
COURSE NAME : URBAN STORMWATER MANAGEMENT COURSE CODE : BFW 40503

FIGURES

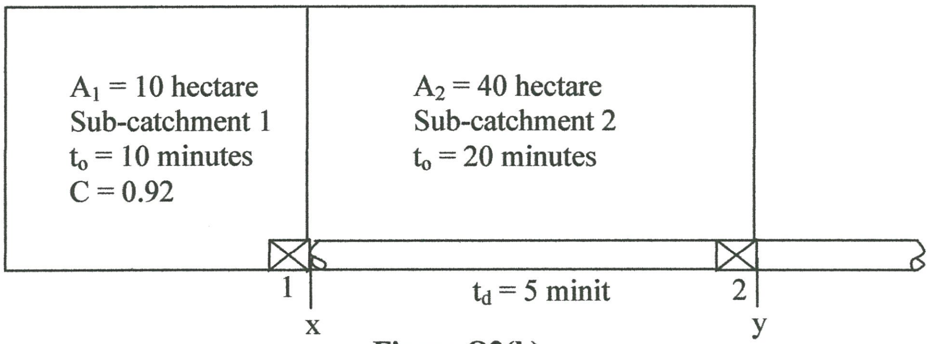

Figure Q2(b)

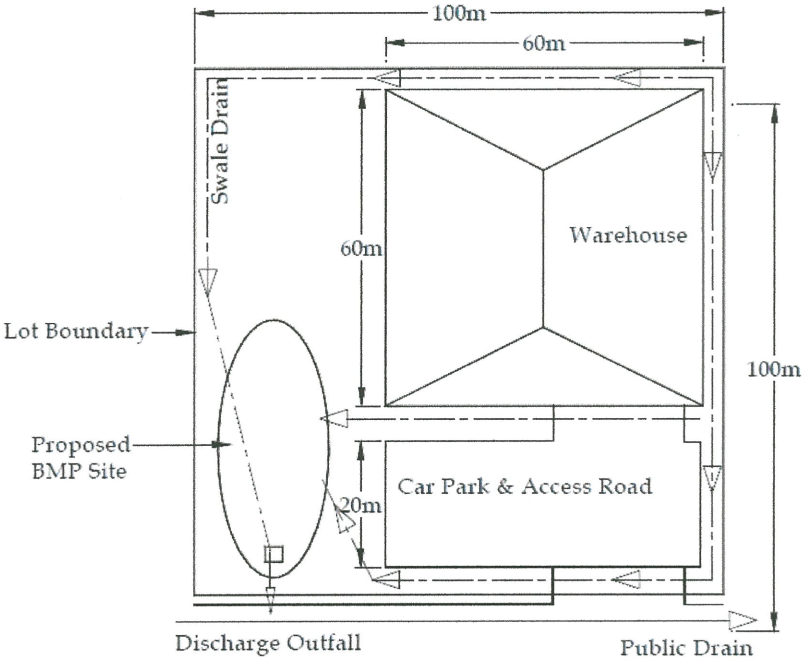

Figure Q4(c)

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2013/2014 PROGRAMME : 4 BFF
COURSE NAME : URBAN STORMWATER MANAGEMENT COURSE CODE : BFW 40503

FIGURES

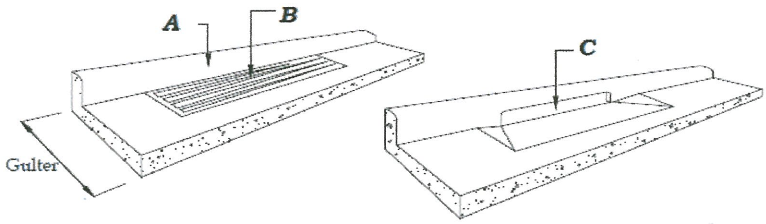

Figure Q6(a)

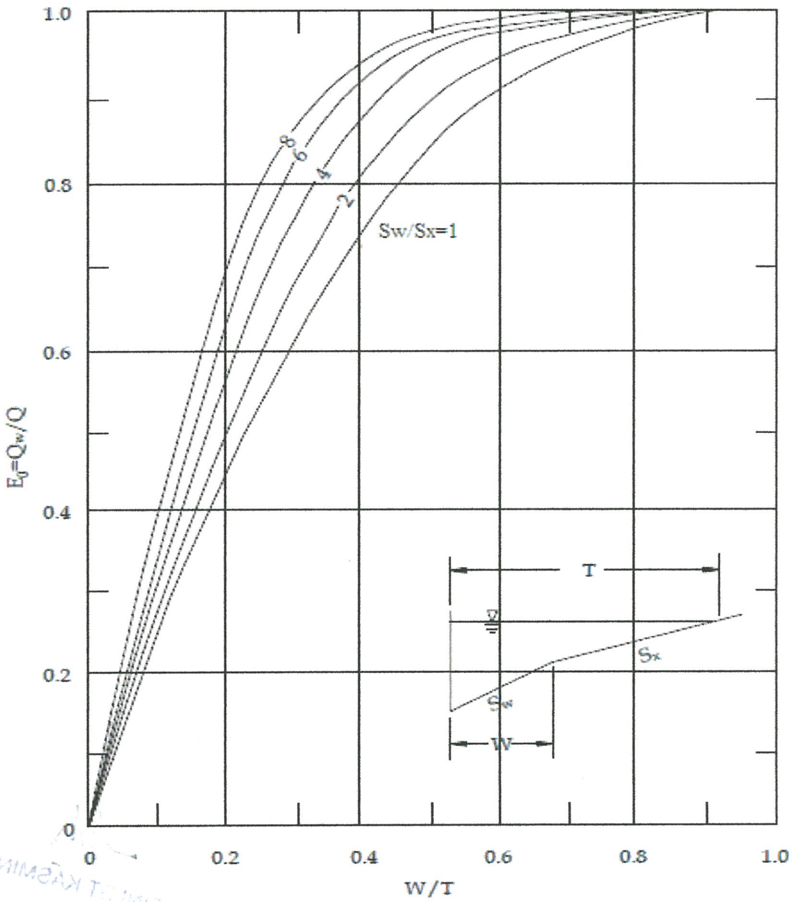

Figure Q6(b)

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2013/2014 PROGRAMME : 4 BFF
COURSE NAME : URBAN STORMWATER MANAGEMENT COURSE CODE : BFW 40503

EQUATIONS

$$i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}} \qquad Q = \frac{C.i.A}{360} \qquad WQV = C.(P_d).A \qquad Q = \frac{k_n T^{8/3} S_x^{5/3} S_L^{1/2}}{2.64n}$$

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

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

TABLES

Table Q2(b)(i) : Recommended runoff coefficients for various landuses

Landuse	Runoff coefficient (C)	
	For Minor System (≤ 10 year ARI)	For Major System (> 10 year ARI)
Residential		
Bungalow	0.65	0.70
Semi-detached bungalow	0.70	0.75
Link and terrace house	0.80	0.90
Flat and apartment	0.80	0.85
Commercial and bussines centres	0.90	0.95
Industrial	0.90	0.95
Sport fields and agriculture	0.30	0.40
Open spaces		
Bare soil (no cover)	0.50	0.60
Grass cover	0.40	0.50
Bush cover	0.35	0.45
Forest cover	0.30	0.40
Road and highways	0.95	0.95

Table Q2(b)(ii): 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	Pusat Kem Pekan Nenas	54.265	0.179	0.100	0.756
	3	1829002	Setor JPS Batu Pahat	64.099	0.174	0.201	0.826
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
Penang	1	5303001	Rumah Kebajikan P Pinang	57.326	0.203	0.325	0.791
	2	5303053	Kompleks Prai	52.771	0.203	0.095	0.717
	3	5402002	Klinik Bkt Bendera	64.504	0.196	0.149	0.723