Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	URBAN STORM WATER MANAGEMENT
COURSE CODE	:	BFW40503
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER A) **ALL** QUESTIONS IN **SECTION A,** AND B) **ANY TWO (2)** QUESTIONS IN **SECTION B**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

SECTION A: ANSWER **ALL** QUESTIONS

Q1 (a) List **TWO (2)** main drainage practices being implemented in Malaysia. (2 marks)

(b) Explain **TWO (2)** impacts of urbanization on the quantity of Urban Stormwater. (4 marks)

(c) Compare **TWO (2)** differences between storage and conveyance facilities. (4 marks)

(d) Classify **FOUR (4)** unified design criteria as suggested in Malaysia Urban Storm Water Manual (MSMA). (10 marks)

Q2 (a) Define the following;

(i) Rational method.
(ii) Rainfall excess.
(iii) Outflow control.
(iv) Peak discharge.

(4 marks)

(b) Briefly explain **THREE (3)** assumptions being used for Rational method. (6 marks)

(c) A rectangular channel has a width of 2.8 m and the depth of 0.5 m was constructed. Calculate the time of concentration for each sub catchment as given in **Table 1**. (4 marks)

(d) The critical storm duration of a conveyance is usually close to time of concentration value. However, depend on several factors the critical storm duration might be significantly different with t_c. Compose **THREE (3)** factors that might contribute to this result. (6 marks)

Q3 (a) Briefly explain **TWO (2)** typical runoff pollutants.

(4 marks)

(b) The selection of BMPs based on-site specific conditions and the overall management objectives of the catchment. Discuss **TWO (2)** selection criteria on the selection of BMPs.

(4 marks)

(c) Determine the annual Total Suspended Solid (TSS) pollution loading (in kg/year) generated from a 250-ha mixed development area. The mean annual rainfall for the catchment is 2630 mm. The catchment characteristics are given in **Table 2 & Table 3**.

(8 marks)

(d) Infiltration facility is one of the BMPs usually constructed to control stormwater. With the aid of sketch, invent your infiltration facilities system to improve the conventional infiltration system.

(4 marks)

SECTION B: ANSWER **ANY TWO** (2) QUESTIONS

Q4 (a) Discuss **TWO (2)** benefits of detention facilities for stormwater management.

(4 marks)

(b) 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, WQ_v = 937.46 m^3, maximum hydraulic head, H_{max} = 1.524 m and C = 0.6.

(4 marks)

(c) Compare **THREE (3)** differences of the functions between detention and retention ponds from engineering purposes.

(6 marks)

(d) Evaluate and propose the solution based on the construction sites where erosion and sediment are occurred:

(i) Unprotected steep slopes are prone to erosion as runoff velocity is high.

(3 marks)

(ii) Any construction works near or at streams or waterways are caused dislodged sediments to enter water directly.

(3 marks)

Q5 (a) Discuss **TWO (2)** functions of road curb.

(4 marks)

(b) A triangular gutter has a longitudinal slope of S_L = 0.04, cross slope of S_x= 0.06, Manning roughness of n = 0.025 and k_u = 0.576 $m^{1/3}/s$. Determine the flow depth and spread if the discharge is 0.186 m^2/s. (4 marks)

(c) There are four types of inlet normally used in pavement drainage. In your opinion, choose and discuss the most suitable inlet type that could be used in the industrial area. (6 marks)

(d) New road is under construction and new design are needed due to changes of on-site requirement. Recommend **TWO (2)** design considerations that need to be considered for street gutter and inlets structures.

(6 marks)

Q6 (a) Provide **TWO (2)** examples of facilities that involve effectively in practice to control stormwater quality.

(4 marks)

(b) Estimate the sediment yield for the catchment as given in **Table 4** by using MUSLE method.

(4 marks)

(c) As an engineer, you are being assigned to monitor Erosion and Sediment Control Plan (ESCP) at site based on the eight principles of ESCP. Compose the works that you need to do during drainage control and runoff management phase. (6 marks)

(d) Recommend **TWO (2)** actions on principles of Erosion and Sediment Control plan (ESCP) to handle the erosion problems according to site conditions..

(6 marks)

– END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2017/2018
COURSE NAME : URBAN STORM WATER MANAGEMENT
PROGRAMME CODE : 4 BFF
COURSE CODE : BFW40503

TABLE 1

Sub-Catchment	Length, Lo	Slope, S	Area, m^2	Perimeter, m	Ld	S, m/m	Manning coefficient, n	Horton roughness, n*
1	54.5	12.24	0.22	1.54	250	0.04	0.035	0.015
2	107.82	26.13	0.18	1.54	678	0.08	0.030	0.018

TABLE 2

Landuse	Area (ha)	Runoff Coefficient, C
Residential	35	0.72
Industry	76	0.85
Commercial	53	0.92
Roads & Highways	86	0.96

TABLE 3

Pollutants		Landuses			
Parameter	Unit	Residential	Commercial	Industry	Highway
TSS	mg/L	128	122	166	80
Turbidity	NTU	122	96	147	69
TDS	mg/L	131	43	137	38
pH	-	6.46	6.77	6.66	6.57

TABLE 4

Zone	Runoff Volume, V (m^3)	Peak discharge, Qp (m^3/s)	K factor	LS factor	C factor	P factor
1	183.2	0.143	0.0286	5.3809	1.00	1.00
2	130.2	0.082	0.0286	0.1467	1.00	1.00

FINAL EXAMINATION

SEMESTER/SESSION	: SEM II / 2017/2018	PROGRAMME CODE	: 4 BFF
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The following information may be useful. The symbols have their usual meaning.

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

$$i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}} \qquad Q = \frac{k_n T^{8/3} S_x^{5/3} S_L^{1/2}}{2.64n} \qquad \gamma = 89.6(VQ_p)^{0.56}(K.LS.C.P)$$

$$A = \frac{3.14d^2}{4} \qquad T = \left(\frac{Qn}{K_u S_x^{1.67} S_L^{0.5}} \right)^{0.375} \qquad d = TS_x \qquad L = \frac{R.EMC.A.C_v}{100}$$

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

$$A_{sb} = \frac{S_Q Z}{K(h_{avg} + Z)T_d} \qquad S_Q = nLWd_t \qquad Q = CA(2gH)^{0.5}$$

$$t_o = \frac{107.n^*.L^{1/3}}{S^{1/5}} \qquad t_g = \frac{L}{40\sqrt{S}} \qquad t_d = \frac{n.L}{60R^{2/3}S^{1/2}}$$