Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESI 2018/2019

COURSE NAME	:	WATER RESOURCES ENGINEERING
COURSE CODE	:	BFW40103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DISEMBER 2018 / JANUARI 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) A 114-ha catchment is estimated to have the time-area relationship and rainfall distribution as outlined in **TABLE Q1 (a)** and **FIGURE Q1 (a)**. Estimate the runoff hydrograph using the time-area method (Please use a factor of 0.0028 to convert ha.mm/h to m^3/s).

(6 marks)

(b) Integrated Water Resources Management (IWRM) is promoted to coordinate management of resources in natural environment. Discuss **THREE (3)** of the IWRM challenges in Malaysia based on the selected key water management issues.

(9 marks)

(c) A bungalow development is proposed in Ipoh with the inclusion of a rainwater harvesting system in the design. Average annual rainwater yield is 99 m^3. Roof area of the bungalow is 200 m^2 with a car porch and garden. The bungalow is designed with four rooms with a twin sharing concept. Each room is equipped with one dual flush toilet. The rainwater demand for domestic application is tabulated in **TABLE Q1 (c)**. Given that domestic water demand is 240 litre/capita/day and average annual rainwater yield (AARY) is 116 (m^3), compute:

(i) Annual rain water demand

(6 marks)

(ii) Rainwater tank size

(2 marks)

(iii) Percentage of rainwater yield over rainwater demand

(2 marks)

Q2 (a) On-site detention (OSD) may be provided as above- or below-ground storages, or a combination of both (composite). Sketch and briefly explain a simple composite storage system.

(5 marks)

(b) Universiti Tun Hussein Onn Malaysia (UTHM) has experienced several water shortage problems. With a systematic schematic diagram, plan a secondary water supply system that utilizes rainwater as alternative water sources.

(5 marks)

(c) The tabulated 2-hr unit hydrograph (UH) for a basin is given in **TABLE Q2(c)**. Convert the 2-hr UH to a 6-hr UH using the S-curve method.

(6 marks)

(d) Using data provided in **TABLE Q2 (d)**, generate the intensity-duration-frequency (IDF) curves (in/hr versus min) for 20-year and 10-year frequencies.

(9 marks)

Q3 (a) Batu Pahat catchment area is expected to be hit by flood in year 2020. As an engineer, suggest the best management practices that can be applied to mitigate the flood magnitude, lost of property as well as life.

(6 marks)

(b) Explain **THREE (3)** precaution analyses measure that need to be taken prior to constructing a dam.

(6 marks)

(c) A reservoir covers an area of 650 km^2 and has an average depth of 14.3 m. The inflow to the reservoir is from a river with an average flowrate of 1900 m^3/s and a suspended sediment concentration of 230 mg/L. Assume that the accumulated sediment has a bulk density of 1600 kg/m^3.

(i) Evaluate the lifespan of the reservoir if no maintenance work is carried out until it reaches less than 50% of the reservoir capacity.

(9 marks)

(ii) As water resources engineer, suggest a solution to secure the water resource problem based on the above result.

(4 marks)

Q4 (a) Irrigation system can have several problems. Clearly explain **THREE (3)** problems related to irrigation system

(6 marks)

(b) The triangular channel reach is 2 km long with the data as shown in **TABLE Q4 (b).** The river has the storage characteristics, S_o = 0.001, e = 0.4 $m^{1/3}/s$, m = 4/3 respectively. By using Muskingum-Cunge method,

(i) Formulate the downstream (outflow) hydrograph with a base flow of 1.7 m^3/s as discharge.

(14 marks)

(ii) Identify the maximum outflow and the storage capacity of the channel.

(5 marks)

– END OF QUESTIONS –

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TABLE Q1 (a) Rainfall excess distribution

Time (min)	Rainfall Intensity (mm/h)
0 – 5	130
5 – 10	64
10 – 15	50
15 – 20	38
20 – 25	
25 – 30	

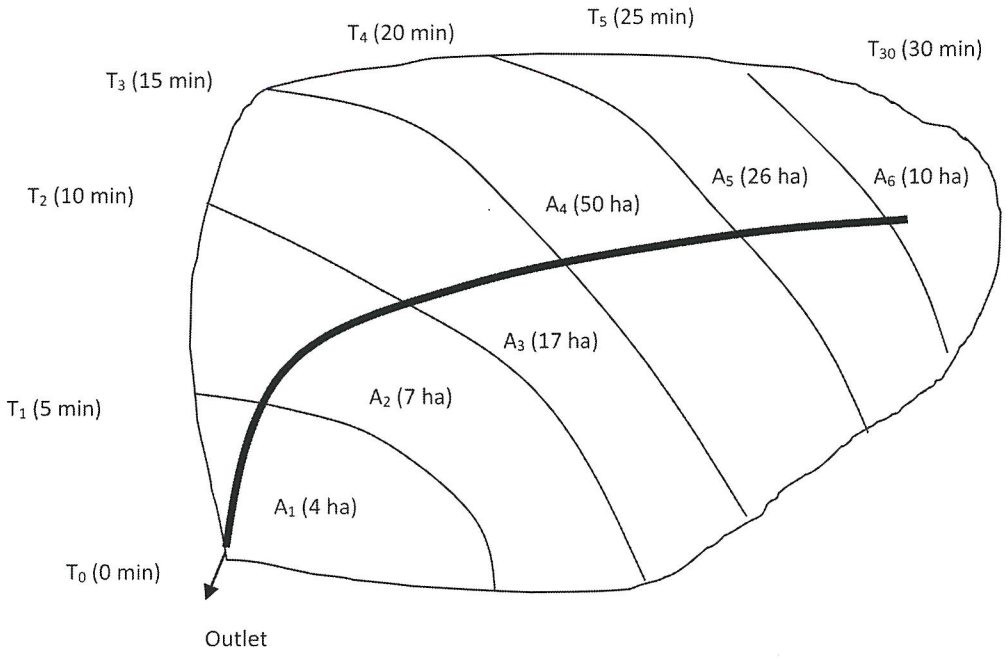

FIGURE Q1 (a) Time-area relationship

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TABLE Q1 (c) Rainwater Demand for Domestic Application (DID, 2009)

Use (Appliance)	Type	Average Consumption	Average Total Rainwater Demand
A. Indoor			
Toilet	Single Flush	9 litres per flush	120 litres per day
	Dual Flush	6 or 3 litres per flush	40 litres per day
Washing Machine	Twin Tub (Semi- auto)		40 litres per wash
	Front Loading		80 litres per wash
	Top Loading		170 litres per wash
Dishwasher	-		20-50 litres per load
General Cleaning	-	10-20 litres per minute per wash	150 litres per day
B. Outdoor			
Sprinkler or Handheld Hose		10-20 litres per minute	1000 litres per hour
Drip System			4 litres per hour
Hosing		20 litres per minute	200 litres per wash
Paths/Driveways			
Washing Car with a Running Hose		10-20 litres per minute	100-300 litres per wash

TABLE Q2 (c) 2-hr unit hydrograph data

Time (h)	2 hr UH (m^3/s.cm)
0	0
1	75
2	250
3	300
4	275
5	200
6	100
7	75
8	50
9	25
10	0

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TABLE Q2 (d) Precipitation data (in) for different durations

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rank	Precipitation (in) of Duration of:						Return
m	5 min	10 min	15 min	20 min	30 min	60 min	Period
1	0.46	0.68	0.89	1.07	1.48	2.15	23
2	0.43	0.65	0.83	0.97	1.29	1.92	11.5
3	0.40	0.63	0.79	0.91	1.26	1.48	7.7
4	0.38	0.61	0.76	0.86	1.06	0.91	5.8
5	0.36	0.60	0.73	0.86	0.83	0.87	4.6
6	0.34	0.59	0.72	0.77	0.82	0.82	3.8
7	0.32	0.55	0.72	0.77	0.78	0.78	3.3
8	0.30	0.52	0.63	0.70	0.78	.	2.9
9	0.29	0.49	0.57	0.67	0.67	.	2.6
10	0.27	0.44	0.56	0.62	0.66	.	2.3
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
22	0.12	0.22	0.32	0.39	0.38	0.41	1.05

TABLE Q4 (b) Relationship between Time and Inflow (m^3/s)

Time step	**Time (hr)**	**Inflow (m^3/s)**
1	0.00	10
2	0.25	16
3	0.50	31
4	2.00	32
5	2.50	20
6	3.25	13
7	3.75	11
8	4.00	10

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EQUATIONS

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

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

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

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