Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	HYDROLOGY
COURSE CODE	:	BFC32002
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE 2017
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **ONE (1)** QUESTION IN **SECTION A**, AND **THREE (3)** QUESTIONS IN **SECTION B**

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

PART A

Q1 (a) Give **THREE (3)** important ecological functions of groundwater and briefly describe each function.

(6 marks)

(b) With the aid of a sketch, explain the differences between confined and unconfined aquifer.

(6 marks)

(c) A 30 cm well fully penetrates an unconfined aquifer of saturated depth 25 cm. When a discharge of 2100 litre per minute was being pumped for a long time, observation wells at radial distances of 30 m and 90 m indicated drawdown of 5 m and 4 m, respectively.

(i) Estimate the coefficient of permeability and transmissivity of the aquifer.

(8 marks)

(ii) Calculate the drawdown at the pumping well.

(5 marks)

PART B

Q2 (a) State **TWO (2)** types of rainfall.

(2 marks)

(b) An open water tank is set up to collect rainfall for watering a small garden. The data of rainfall, evaporation, and water level are taken daily for a week as tabulated in **Table 1**.

(i) Calculate water usage (outflow) for 7 days in mm.

(7 marks)

(ii) If there is no rain for the next 3 days consecutively, is the storage enough to water to the plants?

(5 marks)

(c) Analyze a missing station *C* record of precipitation as shown in **Table 2** by quadrant application for this area.

(11 marks)

Q3 (a) Define the following terms :

(i) Infiltration rate

(2 marks)

(ii) Infiltration capacity

(2 marks)

(b) Explain in detail **ONE (1)** type of Infiltrometer.

(5 marks)

(c) A basin area of 250 hectare produced a mass curve of the average rainfall depth and was recorded as in the **Table 3**. If the ϕ index was found to be 7.85 mm/hr, determine the runoff volume of the catchment in cubic meter.

(8 marks)

(d) A 24 hours storm occurred over a catchment of 2.5 km^2 area and the total rainfall observed was 10 cm. An infiltration capacity curve prepared had the initial infiltration capacity of 1 cm/hour and attained a constant value of 0.3 cm/hour with a Horton's constant $k = 5hr^{-1}$. A pan installed in the catchment area indicated a decrease of 0.6 cm in the water level during the 24 hours of its operation. Calculate the total infiltration loss and volume of runoff (in m^3) from the catchment. Assume a pan coefficient of 0.7.

(8 marks)

Q4 (a) Define the surface runoff

(2 marks)

(b) Define the current meter and differentiate between vertical-axis and horizontal-axis meter.

(6 marks)

(c) A 150 g/L solution of salt was discharged into a stream at a constant rate of 20 L/s. The background concentration of the salt in the stream was found to be 9 ppm (part per million). At a downstream section, the solution was completely mixed and the salt concentration was found to reach an equilibrium value of 45 ppm. Calculate the discharge in the stream.

(3 marks)

(d) The following data in **Table 4** are obtained from the current meter gauging ($V = 0.23N_s + 0.04$) of a stream. Compute the stream discharge by using the mid section method.

(14 marks)

Q5 (a) Define the followings :

(i) S–curve.

(2 marks)

(ii) Time of concentration, t_c.

(2 marks)

(b) Describe the characteristics of a typical hydrograph.

(5 marks)

(c) The streamflow data of a river for a catchment area of 650 km^2 is given in **Table 5**. Plot a hydrograph and separate the baseflow from the direct runoff by using simple method and intersection method. Compare the quantity of the direct runoff of both methods. (Apply both methods on a single graph paper).

(8 marks)

(d) Derive the hydrograph for an excess rainfall of 5.5 mm, 8.5 mm which occurs in the first and second hours. The unit hydrograph ordinates are shown in the **Table 6**.

(8 marks)

Q6 (a) Describe **TWO (2)** usages of reservoir routing method.

(4 marks)

(b) The incremental time period of inflow and outflow of a reservoir is 0.40 hours as shown in **Tables 7** and **8**. Evaluate the design of outflow of 2 m^3/s.

(21 marks)

– END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2016/2017
COURSE NAME : HYDROLOGY
PROGRAMME CODE : 3 BFF
COURSE CODE : BFC32002

TABLE 1

Day	Evaporation (mm)	Rainfall (mm)	Water Level in Tank (mm)
1	1.7	0	1000
2	0	35.4	
3	1.7	0	
4	0	50.8	
5	1.7	0	
6	0	121.6	
7	1.7	0	480

TABLE 2

Station	Rainfall Depth (mm)	Coordinate	
		X	*Y*
A	29	–5	–5
B	21	–1	2
D	17	6	1
E	31	1	1
F	28	3	–2
G	22	4	5
H	19	–5	1

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2016/2017
COURSE NAME : HYDROLOGY
PROGRAMME CODE : 3 BFF
COURSE CODE : BFC32002

TABLE 3

Time (hour)	1	2	3	4	5	6	7
Accumulated Average Rainfall (mm)	7	15.2	60.4	81.5	97.6	120.0	120.0

TABLE 4

Distance from one end of the river (m)	**Depth of water, d (m)**	**Current meter reading at 0.6 of depth**	
		revolution	**time (sec)**
0	0	0	0
1	1.1	39	100
3	2.0	58	100
5	2.5	112	150
7	2.0	89	100
9	1.7	45	100
11	1.0	30	100
12	0	0	0

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2016/2017
COURSE NAME : HYDROLOGY
PROGRAMME CODE : 3 BFF
COURSE CODE : BFC32002

TABLE 5

Time (days)	Flow (m^3/s)
1	600
2	1400
3	5000
4	10500
5	7000
6	4200
7	3800
8	3000

TABLE 6

Time (hours)	Excess Rainfall (mm)	Direct Discharge (m^3/s mm)
1	5.5	1
2	8.5	3
3		7
4		23
5		86
6		66
7		30
8		10
9		3
10		1

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2016/2017
COURSE NAME : HYDROLOGY
PROGRAMME CODE : 3 BFF
COURSE CODE : BFC32002

TABLE 7

Time (hour)	0	0.4	0.8	1.2	1.6	2.0	2.4
Inflow (m^3/s)	0.11	0.17	0.25	0.65	2.38	1.36	0.57

Time (hour)	2.8	3.2	3.6	4	4.4	4.8
Inflow (m^3/s)	0.40	0.31	0.25	0.23	0.20	0.20

TABLE 8

Outflow (m^3/s)	0	0.07	0.71	1.91	3.45
Storage (m^3)	0	212	1019	1698	2547
$\frac{2S}{\Delta t} - O$ (m^3/s)	0	0.22	0.71	0.45	0.09
$\frac{2S}{\Delta t} + O$ (m^3/s)	0	0.37	2.13	4.27	6.99

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2016/2017
COURSE NAME : HYDROLOGY
PROGRAMME CODE : 3 BFF
COURSE CODE : BFC32002

The following information may be useful. The symbols have their usual meaning.

1 ha = 10000 m^2

$$E = C(e_o - e_a)\left[1 + \frac{W}{10}\right]$$

index, $\phi = \dfrac{P - R}{t_e}$

$$f = f_c + (f_o - f_c)e^{-kt}$$

$$I - O = \frac{\Delta S}{\Delta t}$$

$$H^2 - h^2 = \frac{Q}{\pi K}\ln\left(\frac{R}{r}\right)$$

$$H - h = \frac{Q}{2\pi bK}\ln\left(\frac{R}{r}\right)$$

$$Q_2 = C_0 I_2 + C_1 I_1 + C_2 I_1$$

$$C_0 = \frac{0.5\Delta t - Kx}{K(1-x) + 0.5\Delta t}$$

$$C_1 = \frac{0.5\Delta t + Kx}{K(1-x) + 0.5\Delta t}$$

$$C_2 = \frac{K(1-x) - Kx}{K(1-x) + 0.5\Delta t}$$

$$P = \sum\left(\frac{P_i}{n}\right)$$

$$T = KB$$

$$U = K_s B$$

$$P_x = \sum(W_i P_i)$$

$$B = \sum\left(\frac{tp}{100}\right)$$

$$(I_1 + I_2) + \left(\frac{2S_1}{\Delta t} - O_1\right) = \left(\frac{2S_2}{\Delta t} + O_2\right)$$

$$u = \frac{ktp}{100}$$

$$Q = \frac{C_1 - C_2}{C_2 - C_0} \times q$$