UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	HYDROLOGY
COURSE CODE	:	BFC32002
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE / JULY 2016
DURATION	:	2 ½ HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) List **THREE (3)** basic data required for hydrological studies.

(3 marks)

(b) Explain **TWO (2)** various types of recording rain gauges.

(4 marks)

(c) A river reach had a flood wave passing through it. At a given instant the storage of water in the reach was estimated as 15.5 ha.m. Estimate the storage in the reach after an interval of 3 hours with the average inflow and outflow during the time period are 14.2 m^3/s and 10.6 m^3/s respectively. Give your answer in hectare-meter.

(8 marks)

(d) A catchment has five rainfall gauges as shown on **Figure Q1(d)**. The total storm rainfall depths are given as; A = 55 mm, B = 65 mm, C = 82 mm, D = 71 mm and E = 68 mm. Determine the mean precipitation over the area by Thiessen polygon method and compare with the arithmetic mean method.

(10 marks)

Q2 (a) State **FOUR (4)** factors affecting evapotranspiration process.

(4 marks)

(b) Determine the seasonal consumptive use of a tomato crop if the mean monthly temperature for May, June, July and August are 61.6, 70.3, 75.1 and 73.4 °F, respectively. Given k = 0.65, Latitude 30° South. Refer **Table Q2(b)** for the daytime hours coefficient values.

(11 marks)

(c) A sprinkling test is carried out on a plot of 25 m^2. The simulated rainfall intensity (*i*) equals 20 mm/h. After 4 hours, the surface runoff from the plot becomes constant and equal to 0.05 l/s.

(i) Compute the ultimate infiltration capacity in mm/h.

(ii) Draw a graph the infiltration capacity with time, given an initial infiltration rate at the start of the sprinkling test equal to 18 mm/h. In the same figure, draw a graph the infiltration capacity with time for the situation the experiment is repeated a few hours later.

(10 marks)

Q3 (a) Define surface runoff.

(3 marks)

(b) Explain a stage. Describe briefly **THREE (3)** methods commonly used for stage measurement of a river.

(7 marks)

(c) The following data in **Table Q3(c)** are obtained from the current meter gauging ($v = 0.23N_s + 0.04$) of a stream. Compute the stream discharge by using the mean section method.

(9 marks)

(d) A 200 gram/litre solution of salt was discharged into a stream at a constant rate of 25 litre/second. The background concentration of the salt in the stream was found to be 10 ppm (part per million). At a downstream section where the solution have been completely mixed, the salt concentration was found to reach an equilibrium value of 45 ppm. Identify the discharge in the stream.

(6 marks)

Q4 (a) Define the followings:

(i) Hydrograph

(2 marks)

(ii) Unit hydrograph

(2 marks)

(iii) S- Curve

(2 marks)

(b) Discuss in detail **THREE (3)** fundamental assumptions in the use of unit hydrographs.

(9 marks)

(c) A stream catchment has a 2 hours unit hydrograph with the ordinates 0, 3, 11, 35, 55, 66, 63, 40, 22, 9 and 2 m^3/s. Assume that the base flow at time t = 0 is 20 m^3/s and linearly increases to 44 m^3/s at t = 24 hours.

(i) Compute the hydrograph resulting from two successive 2 hour periods of effective rain of 2 cm and 1.5 cm, respectively.

(8 marks)

(ii) To prevent downstream flooding, the maximum flow to be released from the catchment is set at 180 m^3/s. Determine the space needed to store the excess water (Give your answer in m^3).

(2 marks)

Q5 (a) Define flood routing with the aid of a sketch showing the process.

(6 marks)

(b) Describe **THREE (3)** uses of reservoir routing method.

(6 marks)

(c) Given the reservoir routing curves in **Figure 5(c) (i – iv)**. Derive the out flow hydrograph and water elevations in **Table Q5(c)**.

(13 marks)

Q6 (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 difference 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 and 90 meter indicated drawdown of 5 and 4 meter, respectively.

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

(8 marks)

(ii) Calculate the drawdown at the pumping well.

(5 marks)

- END OF QUESTIONS -

FINAL EXAMINATION

SEMESTER/SESSION : SEM II /2015/16 PROGRAMME CODE : BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC32002

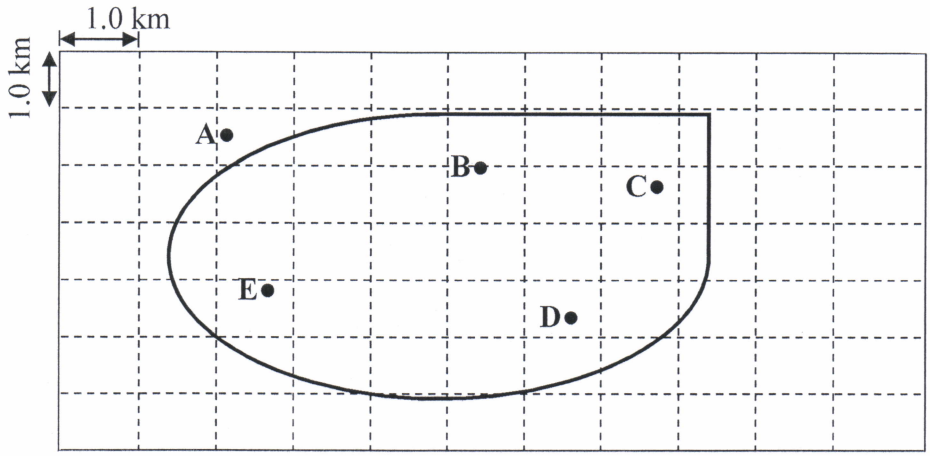

Figure Q1(d) : Catchment with rainfall gauges.

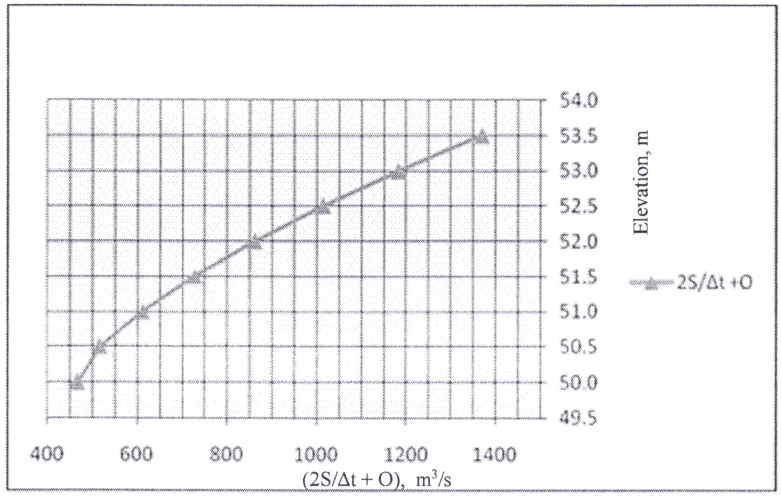

Figure Q5(c)(i): Reservoir rating curve.

FINAL EXAMINATION

SEMESTER/SESSION : SEM II /2015/16 PROGRAMME CODE : BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC32002

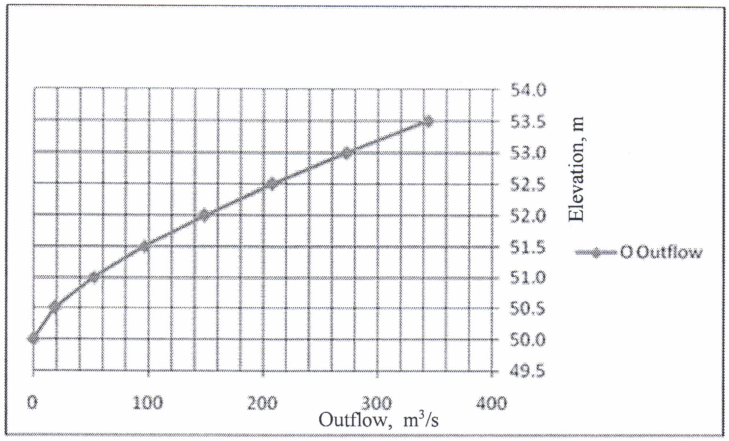

Figure Q5(c)(ii) : Reservoir rating curve.

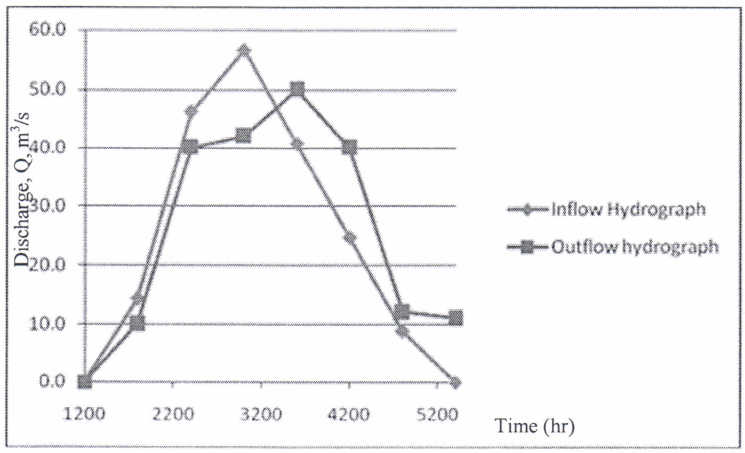

Figure Q5(c)(iii): Reservoir rating curve.

FINAL EXAMINATION

SEMESTER/SESSION : SEM II /2015/16 PROGRAMME CODE : BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC32002

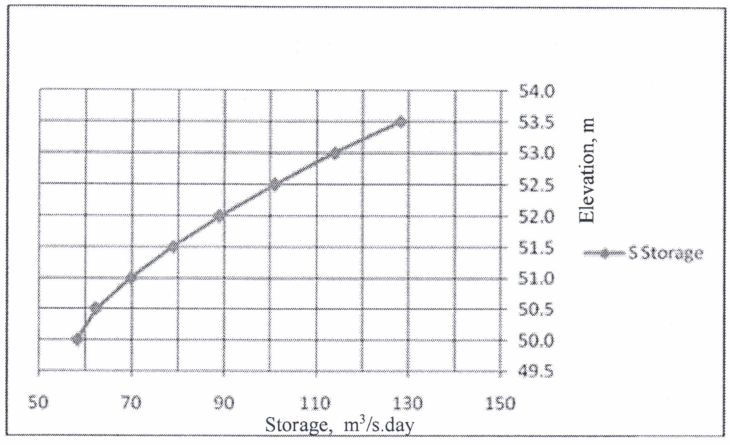

Figure Q5(c)(iv): Reservoir rating curve.

Table Q2(b): Daytime hours coefficient.

Latitude	Month											
North	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
South	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
60°	0.15	0.20	0.26	0.32	0.38	0.41	0.40	0.34	0.28	0.22	0.17	0.13
50°	0.19	0.23	0.27	0.31	0.34	0.36	0.35	0.32	0.28	0.24	0.20	0.18
40°	0.22	0.24	0.27	0.30	0.32	0.34	0.33	0.31	0.28	0.25	0.22	0.21
30°	0.24	0.25	0.27	0.29	0.31	0.32	0.31	0.30	0.28	0.26	0.24	0.23
20°	0.25	0.26	0.27	0.28	0.29	0.30	0.30	0.29	0.28	0.26	0.25	0.25
10°	0.26	0.27	0.27	0.28	0.28	0.29	0.29	0.28	0.28	0.27	0.26	0.26
0°	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

Note: Values for P are determined by dividing the mean daily daytime hours for a specified month by the total daytime hours in a year and then multiplying the ratio by 100.

FINAL EXAMINATION

SEMESTER/SESSION : SEM II /2015/16 PROGRAMME CODE : BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC32002

Table Q3(c): Streamflow measurement

Distance from one end of the river (m)	Depth of water, d (m)	Current meter reading below water surface		
		depth (m)	revolution	time (sec)
0	0	-	-	-
2.00	1.00	0.60	10	40
4.50	2.20	0.44	36	48
		1.76	20	50
7.50	3.40	0.68	40	60
		2.72	30	53
9.50	4.60	0.92	46	62
		3.68	33	58
12.00	4.20	0.84	33	52
		3.36	29	48
14.00	2.50	0.50	34	52
		2.00	29	53
16.50	1.20	0.72	16	48
18.00	0.00	-	-	-

Table Q5(c): Out flow hydrograph and water elevations

		LHS				RHS	
Time (hr)	**Inflow Hydrograph (m^3/s)**	**I_1+I_2**	**O**	**S**	**$2S_1/\Delta t - O_1$ ($\Delta t = 0.25$ days)**	**$2S_2/\Delta t + O_2$**	**Water elevation m (msl)**
1200	0.0	14.3	0	58.2	465.6	479.9	50.2
1800	14.3	60.5	10	60	470	530.5	50.8
2400	46.2	102.9					
0600	56.7	97.4					
1200	40.7	65.5					
1800	24.8	33.6					
2400	8.8	8.8					
0600	0.0	0.0					

FINAL EXAMINATION

SEMESTER/SESSION : SEM II /2015/16 PROGRAMME CODE : BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC32002

EQUATIONS

1 ha = 10000 m^2

$$E = C(e_0 - e_a)\left[1 + \frac{W}{10}\right]$$

$$\text{Index } \phi = \frac{\text{P - R}}{t_e}$$

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

$$I - O = \Delta S/\Delta t$$

$$Q_2 = C_0 I_2 + C_1 I_1 + C_2 Q_1$$

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

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

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

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

$$P = \Sigma\ (P_i / n)$$

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

$$T = KB$$

$$U = K_s B$$

$$P_X = \Sigma\ (W_i . P_i)$$

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

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

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

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