Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	HYDROLOGY
COURSE CODE	:	BFC32002
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2020
DURATION	:	4 HOURS
INSTRUCTION	:	ANSWER: **ALL** QUESTIONS IN **PART A**, AND **ANY ONE (1)** QUESTION IN **PART B.**

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

PART A: ANSWER **ALL** QUESTIONS

Q1 You have been hired as a water consultant by the Department of Drainage (DID), Johor to assess how current flood has affected downstrean of Johor river.

(a) With aid of sketch, propose a routing system that could lessen the impact of the flood within that area.

(4 marks)

(b) Explain **TWO (2)** important judgments needed when developing data for channel reach routing.

(4 marks)

(c) Predict and analyse the outflow of flood hydrograph using an appropriate routing method. The observed inflow flood hydrograph given by the DID is shown in **TABLE Q1(a)**. State your assumptions in the calculation.

(13 marks)

(b) Based on the results obtained from **Q1(c)**, plot and comment on the inflow and outflow rates.

(4 marks)

Q2 (a) Based on your understanding, explain the uses of Unit Hydrograph (UH).

(4 marks)

(b) With your own words, discuss **FIVE (5)** factors that affect hydrograph.

(5 marks)

(c) A catchment area of 9500 km^2 is having the daily stream flow as shown in **TABLE Q1(c)**. Estimate

(i) Total direct flow (in m^3/s) using intersection method. Given $N = 0.8A^{0.2}$.

(10 marks)

(ii) Unit hydrograph (UH) for the catchment.

(6 marks)

Q3 (a) Using your own words, explain the use of pumping test and how it is carried out.

(5 marks)

(b) Discuss the importance of groundwater investigations.

(4 marks)

(c) A 0.5 m well fully penetrates an unconfined aquifer 2.54 m depth. Two observation wells located 2.54 and 6 m from the pumped well are known to have drawdown of 0.6 and 0.03 m, respectively. Estimate the discharge if the flow is steady and $K = 54$ m/day.

(6 marks)

(d) A fully penetrating 40 cm diameter well has its bottom 36 m below the static water table. After 24 hours of pumping at 180 m^3/hr, the water level in the pumped well stabilizes to 4 m below the ground level. A draw-down of 0.85 m is noticed in an observation (test) well 120 m away from the pumped well. If the static water table is 1.50 m below the ground level:-.

(i) determine the hydraulic conductivity of the aquifer in m/min.

(6 marks)

(ii) sketch the section view and the groundwater profile.

(4 marks)

PART B: ANSWER **ANY ONE (1)** QUESTION

Q4 (a) Discuss on the importance of delineating a watershed area.

(4 marks)

(b) Briefly discuss the causes that are responsible for missing data and inconsistency in rainfall record.

(5 marks)

(c) Estimate the amount of rainfall for gauge X by using the arithmetic method for the data given in **TABLE Q4(c)**.

(6 marks)

(d) The annual precipitation for four consistent gauges (A, B, C and D) and one inconsistent gauge (E) are tabulated in **TABLE Q4(d)** from year 1990 to 2000. Gauge E was relocated at a new location at the end of 1993. Analyse and adjust the annual rainfall at gauge E for the period of 1990 to 1993.

(10 marks)

Q5 (a) Using your own words, discuss **TWO (2)** factors that affect infiltration process.

(4 marks)

(b) With the aid of illustration, propose an experiment to determine an infiltration rate.

(5 marks)

(c) The following data in **TABLE Q5(c)** are obtained from the current meter gauging (v = 0.23Ns + 0.04) of a stream. Compute the stream discharge by using mid-section method.

(6 marks)

(d) Using the Penman method, estimate evapotranspiration (ET), given the following data: temperature at water surface – 26°C, temperature of air = 30°C, relative humidity = 35%, wind velocity = 3 mph, the month is March at latitude 35° North, *r* is given as 0.07, and *S* is found to be 0.69. Refer **TABLE Q5(d)(i)-(ii)** and **FIGURE Q5(d)(i)-(ii)**.

(10 marks)

END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2019/2020
COURSE NAME : HYDROLOGY
PROGRAMME CODE : 3 BFF
COURSE CODE : BFC32002

TABLE Q1(a) Inflow and outflow data

Time	Inflow (m^3/s)
0600	10
1200	40
1800	110
2400	200
3000	95
3600	74
4200	54
4800	35
5400	12

*X = 0.3~0.4 and K = 15~16 hours

2(TABLE Q2(c) Daily Streamflow Data

Time (day)	**Total flow, Q (m^3/s)**	**Time (day)**	**Total flow, Q (m^3/s)**
1	1600	9	3800
2	1400	10	2800
3	5000	11	2200
4	8500	12	1850
5	10000	13	1600
6	9500	14	1400
7	7500	15	1400
8	5000	16	1400

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2019/2020
COURSE NAME : HYDROLOGY
PROGRAMME CODE : 3 BFF
COURSE CODE : BFC32002

TABLE Q4(c) Rainfall Data

Stations	Amounts of precipitation (mm)	Normal annual precipitation (mm)
A	40	750
B	45	800
C	53	680
X	?	720

TABLE Q4(d) Annual Rainfall Data

Year & Station	Annual rainfall (mm)				
	A	B	C	D	E
1990	28	29	29	34	34
1991	29	32	31	33	36
1992	31	31	28	34	38
1993	29	28	35	35	29
1994	32	34	32	29	31
1995	34	33	29	32	28
1996	36	34	33	34	29
1997	38	35	29	34	31
1998	29	32	32	35	29
1999	32	29	31	32	32
2000	34	33	28	29	32

TABLE Q5(c) Streamflow measurement

Distant from left of water edge (m)	0	3	6	9	11	15	18	19
Depth (m)	0	1.5	2.5	2	2.3	2	1.2	0
Revolutions of a current meter kept at 0.6d	0	30	46	90	120	45	32	0
Duration of observations (s)	0	100	100	110	130	100	100	0

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2019/2020
COURSE NAME : HYDROLOGY
PROGRAMME CODE : 3 BFF
COURSE CODE : BFC32002

TABLE Q5(d)(i) Tabulated values of ***R***, mean monthly intensity of solar radiation on a horizontal surface, for use in the Penman Equation

	Latitude (deg)	J	F	M	A	M	J	J	A	S	O	N	D
North	60	1.3	3.5	6.8	11.1	14.6	16.5	15.7	12.7	8.5	4.7	1.9	0.9
	50	3.6	5.9	9.1	12.7	15.4	16.7	16.1	13.9	10.5	7.1	4.3	3.0
	40	6.0	8.3	11.0	13.9	15.9	16.7	16.3	14.8	12.2	9.3	6.7	5.5
	30	8.5	10.5	12.7	14.8	16.0	16.5	16.2	15.3	13.5	11.3	9.1	7.9
	20	10.8	12.3	13.9	15.2	15.7	15.8	15.7	15.3	14.4	12.9	11.2	10.3
	10	12.8	13.9	14.8	15.2	15.0	14.8	14.8	15.0	14.9	14.1	13.1	12.4
	0	14.5	15.0	15.2	14.7	13.9	13.4	13.5	14.2	14.9	15.0	14.6	14.3
South	10	15.8	15.7	15.1	13.8	12.4	11.6	11.9	13.0	14.4	15.3	15.7	15.8
	20	16.8	16.0	14.6	12.5	10.7	9.6	10.0	11.5	13.5	15.3	16.4	16.9
	30	17.3	15.8	13.6	10.8	8.7	7.4	7.8	9.6	12.1	14.8	16.7	17.6
	40	17.3	15.2	12.2	8.8	6.4	5.1	5.6	7.5	10.5	13.8	16.5	17.8
	50	17.1	14.1	10.5	6.6	4.1	2.8	3.3	5.2	8.5	12.5	16.0	17.8
	60	16.6	12.7	8.4	4.3	1.9	0.8	1.2	2.9	6.2	10.7	15.2	17.5

[a]Measured in mm H_2O evaporated per day.

Source: After Criddle [23].

TABLE Q5(d)(ii) Values of temperature-dependent coefficient B for use in the Penman equation

T_a (°K)	***B*** **(mm H_2O/day)**	T_a (°F)	***B*** **(mm H_2O/day)**
270	10.73	35	11.48
275	11.51	40	11.96
280	12.40	45	12.45
285	13.20	50	12.94
290	14.26	55	13.45
295	15.30	60	13.96
300	16.34	65	14.52
305	17.46	70	15.10
310	18.60	75	15.65
315	19.85	80	16.25
320	21.15	85	16.85
325	22.50	90	17.46
		95	18.10
		100	18.80

Note : $B = \sigma T_a$ where :-

σ is the Boltzmann constant, 2.01×10^{-9} mm/day

$°K = °C + 273°$ *or* $°F = 1.8(°C) + 32°$

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2019/2020
COURSE NAME : HYDROLOGY
PROGRAMME CODE : 3 BFF
COURSE CODE : BFC32002

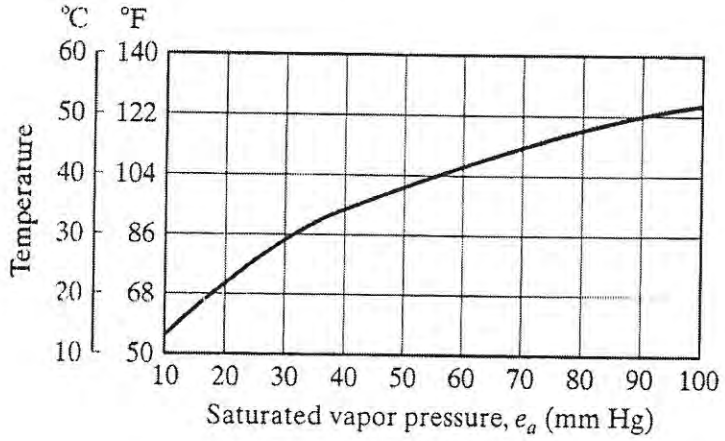

FIGURE Q5(d)(i) Relation between temperature and saturated vapour pressure

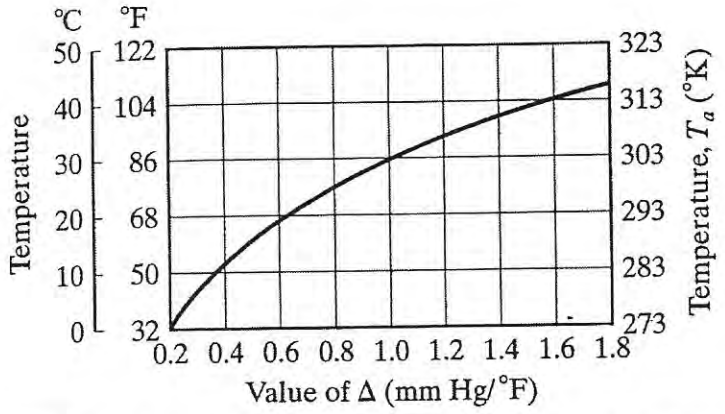

Figure Q5(d)(ii) Temperature versus Δ relation for use with the Penman equation