UNIVERSITI SAINS MALAYSIA

1st. Semester Examination
2000/2001 Academic Session

SEPTEMBER / OCTOBER 2000

EAH325/3 – Engineering Hidrology

Time : [3 hours]

Instruction to candidates:-

1. This paper consists of **SEVEN (7)** questions. Answer **FIVE (5)** questions only.

2. Answers **MUST BE** written in Bahasa Malaysia.

1. (a) The annual rainfall at Station A and the average annual rainfall at 10 surrounding stations are given in the table below.

(i) Determine the consistency of the record at Station A.
(ii) In what year is a change in regime indicated?
(iii) Compute the mean annual rainfall for Station a for the entire 30 year period without adjustment.
(iv) Repeat part (iii) for Station A at its 1971 site with the data adjusted for the change in regime.

Table 1

	Annual Rainfall (cm)	
Year	Station A	10 Station Average
1971	50.5	71.5
1972	90.0	57.0
1973	6.0	27.5
1974	21.5	25.0
1975	50.5	60.5
1976	62.5	22.0
1977	69.5	55.0
1978	36.0	57.0
1979	42.0	36.5
1980	42.0	19.0
1981	36.0	27.5
1982	42.0	60.5
1983	18.0	55.0
1984	30.0	38.5
1985	54.0	38.5
1986	48.0	47.5
1987	12.0	49.5
1988	36.0	24.0
1989	42.0	44.0
1990	36.0	60.5
1991	44.5	47.5
1992	9.5	29.5
1993	45.5	40.5
1994	31.2	56.0
1995	43.5	40.5
1996	39.5	38.5
1997	24.0	55.0
1998	44.5	42.0
1999	36.0	46.0
2000	36.0	49.5

(12 marks)

1. (b) Rainfall Station at Tronoh was inoperative for a period of one month. The rainfall recorded during the month at three surrounding stations A, B and C were 170mm, 195mm and 120mm, respectively. The normal annual rainfall at stations X, A, B and C are 2500mm, 2300mm, 2380mm and 1700mm, respectively. Estimate the monthly rainfall at station X and give reasons for selecting the method use.

(5 marks)

(c) Describe different types of rain gauges. What are the errors associated with rainfall measurement?

(3 marks)

2. (a) A pumping test was made on a new irrigation well. The well was pumped at a rate of 22litres/second. The drawdown was measured in an observation well located 50.5m from the pumped well and the data obtained is given in the Table 2.
   (i) Plot the data.
   (ii) Find the valves of T and S for this aquifer. Compute the formation constants by using Jacob semi-logarithmic graph.

Table 2

Elapsed time (h)	Drawdown (m)
0.5	0.091
1.8	0.294
3.0	0.382
6.0	0.550
9.0	0.701
12.0	0.785
18.0	0.911
30.0	1.060
54.0	12.40

(10 marks)

(b) Calculate the steady-state discharge and transmissivity if the drawdown at observation wells remains constants at 20m and 15m corresponding to observation wells 100m and 200m from the proposed well location. The unconfined aquifer permeability is 5×10^{-5} m/s and the aquifer thickness is 80m.

(4 marks)

(c) Briefly described the following terms:-
   (i) Confined aquifer.
   (ii) Over explanation of groundwater.

(6 marks)

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3. (a) Briefly describe the standard method to measure infiltration in Malaysia.

(3 marks)

(b) A hydrologist designing a stormwater drainage system requires an infiltration experiment for a new pond area to evaluate the infiltration characteristics of the clay loam soil. The results of the test are given in the data Table 3. The inside diameter of the infiltrowater is 35cm and the area is 962cm^2.

(i) Determine the infiltration capacity for the time intervals in the experiment.
(ii) What is the initial infiltration, f_o, in Horton's equation?
(iii) What is the ultimate infiltration, f_c, in Horton's equation?
(iv) If recession rate (k) is 0.25hr^{-1}, find the volume of infiltration for 1 hectare pond infiltration area after 2 hours of infiltration.

Table 3

Elapsed time (min)	Volume of water added since start (cc)
0	0
2	250
5	600
10	1050
20	1800
30	2400
60	3300
90	3850
150	4700

(10 marks)

(c) Estimate the volume of water that will infiltrate into a soil before surface saturation occurs using the Green-Ampt equation. The following data are known:

Saturated moisture content	= 0.25
Initial moisture content	= 0.0
Average rainfall rate	= 5.00mm/hr
Average capillary suction head	= 10.0mm
Saturation conductivity (K_s)	= 2.5mm/hr

What is the maximum soil storage volume if the soil is homogeneous to a water table depth of 1.5m?

(7 marks)

4. (a) The average daily class A pan evaporation is 5mm and the pan coefficient is 0.9. Estimate how much water must be released from the reservoir to satisfy the 48,000m^3 need if the average river width is 60m and the distance down the center of the river from the reservoir to point of need is 70km. Express your answers in terms of m^3. Neglect or assume that net infiltration into and out of the river from groundwater sources is negligible and there is no transpiration.

(6 marks)

(b) Discuss the importance of evaporation in water resources planning. How can evaporation losses be reduced?

(4 marks)

(c) Describe how the shape of the streamflow hydrograf changed for a catchment which subjects to urbanisation.

(5 marks)

(d) The value of a rational coefficient (c) for a catchment which is covered with 100% impermeable surface is 1.0. And if the impermeable surface is reduced by 50% the c value is 0.50. Complete the table below for a catchment area of 20km^2 by determining the total runoff (Q).

% impermeable surface	Total rainfall (cm)	Q
20	10	
60	10	
80	10	

(5 marks)

5. (a) Give **FOUR (4)** criteria for the selection for a river gauging station location.

(4 marks)

(b) During a flood the water levels for a 10cm width rectangular channel separated by 200m are 3.0m at upstream section and 2.9m at downstream section. For a reach with 0.12m drop in water level and n = 0.025 determine the flood discharge.

(16 marks)

6. (a) Give **FIVE (5)** assumption of a unit hidrograph. (5 marks)

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6. (b) Derive a direct runoff hydrograph using the effective rainfall and ½ hr - μH given in the table below. Determine the catchment area used in deriving the ½ hr - μH tabulated in table below.

Time (hr)	Effective rainfall (cm)	½ hr - μH (m^3/s/cm)
0.0	2.7	4.49
0.5	4.9	12.02
1.0	4.6	26.09
1.5		27.93
2.0		16.29
2.5		5.01
3.0		4.28
3.5		3.06
4.0		1.86

(15 marks)

7. (a) Describe the following:
(i) return period
(ii) flood risk
(iii) exceedance probability

(6 marks)

(b) The annual flow volumes ($10^6 m^3$) passing through River Perai at Ara Kuda (Stn. No. 540 5421) are given below:

Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Flow ($M.m^3$)	187	260	192	211	178	184	217	153	178	265

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Flow ($M.m^3$)	179	192	202	135	190	163	155	119	150	188

Determine the median flow volume from the above data.

Assuming Normal distribution, compute:

(i) the exceedence probability of the median value.

(ii) The probability that next years flow volume will be between 140 and 221 million ($M.m^3$).

(iii) Return period value for the largest flow volume on record from 1961 to 1980.

Comment on the advisability of assuming Normal distribution.

(14 marks)

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