
UNIVERSITI SAINS MALAYSIA

2nd. Semester Examination
2005/2006 Academic Session
*Peperiksaan Semester Kedua
Sidang Akademik 2005/2006*

April / May 2006

EAH 325E/3 – Engineering Hydrology
EAH 325E/3 – Hidrologi Kejuruteraan

*Duration: 3 hours
Masa : 3 jam*

Instructions To Candidates:

Arahan Kepada Calon:

1. Ensure that this paper contains **NINE (9)** printed pages including appendices before you start your examination.
*Sila pastikan kertas peperiksaan ini mengandungi **SEMBILAN (9)** muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.*
2. This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions only. Marks will be given to the **FIRST FIVE (5)** questions put in order on the answer script and **NOT** the **BEST FIVE (5)**.
*Kertas ini mengandungi **ENAM (6)** soalan. Jawab **LIMA (5)** soalan sahaja. Markah hanya akan dikira bagi **LIMA (5)** jawapan **PERTAMA** yang dimasukkan di dalam buku mengikut susunan dan bukannya **LIMA (5)** jawapan terbaik.*
3. All questions **CAN BE** answered in English or Bahasa Malaysia or combination of both languages.
Semua soalan boleh dijawab dalam Bahasa Inggeris atau Bahasa Malaysia ataupun kombinasi kedua-dua bahasa.
4. Each question **MUST BE** answered on a new sheet.
*Tiap-tiap jawapan **MESTILAH** dimulakan pada muka surat yang baru.*
5. Write the answered question numbers on the cover sheet of the answer script.
Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.

1. (a) What is a hydrologic cycle? Name the various components of a hydrological cycle.

(5 marks)

Terangkan tentang kitaran hidrologi dan berikan komponen yang berkaitan dengan kitaran hidrologi.

- (b) A river reach had a flood wave passing through it. At a given instant the storage water in the reach was estimated as 15.5 ha.m. (hectare meter). What would be the storage in the reach after an interval of 3 hours if the average inflow and outflow during the time period are 14.2 m³/s and 10.6 m³/s, respectively?

(7 marks)

Gelombang banjir melalui sebatang sungai. Pada suatu ketika storan air dalam ruas sungai tersebut dianggarkan sebanyak 15.5 ha.m. (hektar meter). Tentukan storan dalam ruas sungai tersebut selepas sela masa 3 jam sekiranya purata aliran masuk dan aliran keluar dalam sela masa tersebut masing-masing adalah 14.2 m³/s dan 10.6 m³/s.

- (c) Over a two-month period of time, a catchment is expected to receive 254 mm of rain with an expected evapotranspiration estimated as 85 mm and that lost to groundwater storage of 20 mm. There is no other significant storage in the watershed.

- i. What is the expected rainfall excess to a reservoir storage area if the catchment area is 65 km²? Express your answer in cubic meters and liters.
- ii. Also determine how many people can be served by this water if the per person per day water use rate is 161.41 liters.

(8 marks)

Suatu kawasan tadahan menerima sebanyak 254 mm hujan dengan anggaran sejatpeluhan 85 mm dan kehilangan kepada storan air bumi sebanyak 20 mm. Selain dari itu tidak ada storan lain yang signifikan dalam kawasan tadahan tersebut.

- i. *tentukan lebihan lebat hujan dalam kawasan storan takungan sekiranya kawasan tadahan tersebut adalah seluas 65 km². Berikan jawapan dalam meter padu atau liter.*
- ii. *tentukan jumlah penduduk yang boleh dibekalkan oleh jumlah isipadu air tersebut sekiranya kadar penggunaan air adalah 161.41 liter/orang.*

2. (a) How would you determine statistically, the optimum number of rain gauges required to be installed in a given catchment?

(5 marks)

Bagaimanakah untuk menentukan secara statistik bilangan optimum tolok hujan untuk suatu kawasan tadahan.

2. (b) Using Thiessen's method, find the mean precipitation for the rectangular area given with precipitations marked in Figure 1.

Tentukan purata hujan menggunakan kaedah Thiessen untuk kawasan ABCD berdasarkan kedalaman hujan pada titik A, B, C dan D seperti yang ditunjukkan pada Rajah 1.

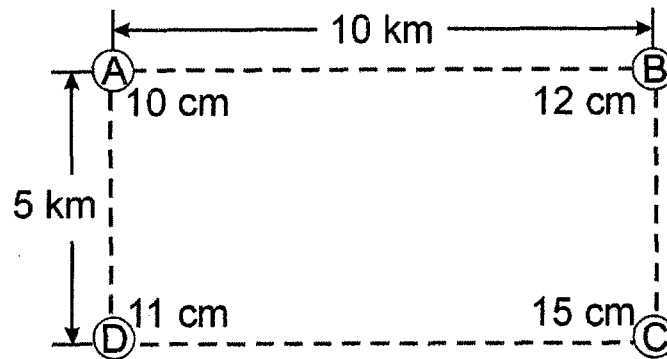


Figure 1

(7 marks)

- (c) A reservoir with a surface area of 300 hectares has the following average meteorological values during a given week;
- | | |
|--|------------------|
| Water temperature | = 30°C |
| Relative humidity | = 50% |
| Saturation vapor pressure at 30°C | = 31.82 mm of Hg |
| Wind velocity at 1m above surface | = 12 km/h |
| Mean barometric reading | = 750 mm of Hg |
| Using Meyer's formula and assuming K_M | = 0.36 |

Estimate:

- i. the average daily evaporation from the reservoir and
- ii. the volume of water evaporated from the lake during the week.

(8 marks)

Suatu takungan dengan keluasan permukaan 300 hektar mempunyai data purata untuk tempoh seminggu seperti berikut:

Suhu air	= 30°C
Kelembapan bandingan	= 50%
Tekanan wap air tepu pada 30°C	= 31.82 mm of Hg
Halaju angin 1 m dari permukaan air	= 12 km/h
Bacaan purata barometrik	= 750 mm of Hg
Gunakan persamaan Meyer dengan anggapan $K_M = 0.36$	

Anggarkan:

- i. purata penyejatan harian daripada takungan
- ii. isipadu penyejatan daripada takungan dalam tempoh masa seminggu.

3. (a) Distinguish between the followings

- i. Aquifer and aquitard
- ii. Influent and effluent stream

(4 marks)

Terangkan perbezaan diantara perkara berikut:

- i) akuifer dan akuitard*
- ii) sungai influen dan efluen*

(b) A 30 cm diameter well penetrates 25 m below the static water table. After 24 hours of pumping at a steady rate of 5400 lpm, the water level in an observation well 90 m away is lowered by 0.53 m, and in another observation well 30 m away the drawdown is 1.11 m.

- i. What is the transmissibility of the aquifer?
- ii. Also determine the drawdown at the main well.

(8 marks)

Telaga bergaris pusat 30 cm menembusi 25m dibawah paras statik air bumi. Pengepaman untuk jangka masa 24jam dengan kadar mantap 5400 lpm mendapati surutan di dalam telaga pemerhatian yang terletak 90m dan 30m daripada telaga pengepaman adalah 0.53m dan 1.11m, masing-masing.

- i. tentukan keterusan (transmissivity) akuifer tersebut*
- ii. tentukan surutan pada telaga pengepaman*

(c) The infiltration capacities of an area at different intervals of time are indicated below. Find an equation for the infiltration capacity in the exponential form.

Kapasiti penyusupan untuk suatu kawasan diberikan di dalam Jadual 1 di bawah. Tentukan persamaan exponen (exponential equation) untuk kapasiti penyusupan.

Table 1

Time, t (hour)	0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Masa, t (jam)									
Infiltration capacity, f (cm/h)	10.4	5.6	3.2	2.1	1.5	1.2	1.1	1	1
Kapasiti Penyusupan, f (cm/j)									

(8 marks)

4. (a) Give **FOUR (4)** factors which should be considered in the selection of streamflow gauging station. (5 marks)

Berikan EMPAT (4) faktor yang mempengaruhi pemilihan stesen pengukuran kadarair sungai.

- (b) Give **FOUR (4)** factors which should be considered in the selection of streamflow gauging method. (5 marks)

Berikan EMPAT (4) faktor yang mempengaruhi pemilihan kaedah pengukuran kadarair sungai.

- (c) Compute the runoff from 127 mm of rainfall on a 250 hectare watershed. The hydrologic soil group is 50% Group B and 50% Group C interspersed throughout the watershed. The land use and corresponding curve number (for antecedent moisture condition II) are given in Table 2. (10 marks)
- i) compute the runoff with the antecedent moisture condition II.
 ii) compute the runoff with the antecedent moisture condition III.

Hitung airlarian terus daripada 127 mm hujan pada kawasan tadahan 250 hektar. Kawasan tadahan terdiri dari 50% Kumpulan tanah Hidrologik B dan 50% Kumpulan tanah Hidrologik C. Guna tanah dan nombor lengkung (untuk keadaan lembapan lampau II) diberikan pada Jadual 2.

- i) hitung airlarian terus dengan keadaan lembapan lampau II.
 ii) hitung airlarian terus dengan keadaan lembapan lampau III.*

Table 2

Land use	Hydrologic Soil Group			
	B		C	
	%	CN	%	CN
Residential (30% impervious)	20	72	20	81
Residential (65% impervious)	6	85	6	90
Roads	9	98	9	98
Open land:				
Good Cover	4	61	4	74
Fair Cover	4	69	4	79
Parking lots, etc.	7	98	7	98

5. Streamflow hydrograf generated from uniform rainfall event with 15 minute duration occurring on 100 hectare catchment is given in Table 3. The baseflow for the river is estimated at 2.5 m³/s. Compute the following:

- i) Effective rainfall
- ii) 15 minute unit hydrograph for the catchment
- iii) 30 minute unit hydrograph for the catchment

(20 marks)

Hidrograf kadaralir sungai daripada suatu peristiwa hujan seragam dalam tempoh 15 minit untuk kawasan tadahan seluas 100 ha di berikan pada Jadual 3. Aliran dasar untuk sungai tersebut adalah sebanyak 2.5 m³/s. Tentukan perkara berikut:

- i) hujan efektif*
- ii) 15 minit unit hidrograf*
- iii) 30 minit unit hidrograf*

Table 3

Time (hour)	Streamflow Discharge (m ³ /s)
0	2.5
0.25	9.5
0.50	11.5
0.75	18.5
1.00	29.5
1.25	40.5
1.50	48.5
1.75	55.5
2.00	50.5
2.25	41.5
2.50	33.5
2.75	28.5
3.00	19.5
3.25	13.5
3.50	9.5
3.75	5.5
4.00	2.5

6. (a) The values of annual rainfall in College Station, Nibong Tebal from 1911 to 1979 are shown in Table 4. What is the probability that the annual rainfall X in any year will be less than 35 in? Greater than 45 in? Between 35 and 45 in?
(6 marks)

Jadual 4 menunjukkan purata hujan tahunan di College Station, Nibong Tebal untuk tahun 1911 sehingga 1979. Tentukan kebarangkalian hujan tahunan X kurang daripada 35 in? Melebihi 45 in? Di antara 35 dan 45 in?

- (b) The mean and standard deviation for the annual rainfall for College Station, Nibong Tebal given in Table 4 are equal to 39.77 and 9.17, respectively. Based on the annual rainfall data determine the following:
- prove that the mean and standard deviation of the annual rainfall at College Station, Nibong Tebal are equal to 39.77 and 9.17, respectively.
 - determine the probability that the annual rainfall is less than 45 in, $P(X < 45)$.
 - determine the probability that the annual rainfall is less than 60 in, $P(X < 60)$.
 - determine the probability that the annual rainfall is less than or equal to 60 but greater than or equal to 45 in $P(45 \leq X \leq 60)$.
- (14 marks)

Purata dan sisihan Piawai untuk purata hujan tahunan di College Station, Nibong Tebal dalam Jadual 3 adalah masing-masing 39.77 dan 9.17. Berdasarkan kepada data hujan tersebut tentukan perkara berikut:

- buktikan purata dan sisihan piawai purata hujan tahunan di College Station adalah masing-masing 39.77 dan 9.17.*
- tentukan kebarangkalian purata hujan tahunan kurang dari 45 in, $P(X < 45)$.*
- tentukan kebarangkalian purata hujan tahunan kurang dari 60 in, $P(X < 60)$.*
- Tentukan kebarangkalian purata hujan tahunan kurang/bersamaan dengan 60 in dan melebihi/bersamaan 45 in $P(45 \leq X \leq 60)$.*

Table 4 : Annual Rainfall (inch) in College Station, Nibong Tebal.

Jadual 4 : Purata Hujan Tahunan untuk College Station, Nibong Tebal (inci).

Year	1910	1920	1930	1940	1950	1960	1970
0		48.7	44.8	49.3	31.2	46.0	33.9
1	39.9	44.1	34.0	44.2	27.0	44.3	31.7
2	31.0	42.8	45.6	41.7	37.0	37.8	31.5
3	42.3	48.4	37.3	30.8	46.8	29.6	59.6
4	42.1	34.2	43.7	53.6	26.9	35.1	50.5
5	41.1	32.4	41.8	34.5	25.4	49.7	38.6
6	28.7	46.4	41.1	50.3	23.0	36.6	43.4
7	16.8	38.9	31.2	43.8	56.5	32.5	28.7
8	34.1	37.3	35.2	21.6	43.4	61.7	32.0
9	56.4	50.6	35.1	47.1	41.3	47.4	51.8

TABLE D.1 Normal Distribution Function Table

$$F(z) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^z e^{-\frac{t^2}{2}} dt$$

Z	.0	.0100	.0200	.0300	.0400	.0500	.0600	.0700	.0800	.0900
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.10	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5733
.20	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.30	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.40	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.50	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.60	.7257	.7291	.7324	.7356	.7389	.7422	.7454	.7486	.7517	.7549
.70	.7580	.7611	.7642	.7673	.7703	.7734	.7764	.7793	.7823	.7852
.80	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.90	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.00	.8413	.8437	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.10	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.20	.8849	.8869	.8888	.8906	.8925	.8943	.8962	.8980	.8997	.9015
1.30	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.40	.9192	.9207	.9222	.9236	.9251	.9265	.9278	.9292	.9306	.9319

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TABLE D.1 (Continued)

Z	.0	.0100	.0200	.0300	.0400	.0500	.0600	.0700	.0800	.0900
1.50	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.60	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.70	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.80	.9641	.9648	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.90	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.00	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.10	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.20	.9861	.9864	.9868	.9871	.9874	.9878	.9881	.9884	.9887	.9890
2.30	.9893	.9895	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.40	.9918	.9920	.9922	.9924	.9926	.9928	.9930	.9932	.9934	.9936
2.50	.9938	.9940	.9941	.9943	.9944	.9946	.9949	.9948	.9951	.9952
2.60	.9953	.9955	.9956	.9957	.9958	.9960	.9961	.9962	.9963	.9964
2.70	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.80	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.90	.9981	.9982	.9982	.9983	.9983	.9984	.9985	.9985	.9985	.9986
3.00	.9986	.9987	.9987	.9988	.9988	.9988	.9989	.9989	.9990	.9990
3.10	.9990	.9991	.9991	.9991	.9991	.9992	.9992	.9992	.9993	.9993
3.20	.9993	.9993	.9993	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.30	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9996
3.40	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997