
UNIVERSITI SAINS MALAYSIA

2nd. Semester Examination
2004/2005 Academic Session
*Peperiksaan Semester Kedua
Sidang Akademik 2004/2005*

March 2005

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 **EIGHT (8)** printed pages included appendices.
Sila pastikan kertas peperiksaan ini mengandungi LAPAN (8) 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. All question **MUST BE** answered on a new sheet.
Semua jawapan MESTILAH dijawab 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? Draw a schematic diagram of a hydrologic cycle and show the various components of the hydrologic cycle.

(a) *Terangkan tentang kitaran hidrologi dan sertakan lakaran yang menunjukkan komponen yang berkaitan dengan kitaran hidrologi.*

(6 marks)

(b) A lake has a water surface elevation of 103.2m above datum at the beginning of a certain month. In that month the lake received an average inflow of 6.0 m³/s from surface runoff sources. In the same period the outflow from the lake had an average value of 6.5m³/s. Further in that month, the lake received a rainfall of 145 mm and the evaporation from the lake surface was estimated as 6.10 cm. Write the water budget equation for the lake and calculate the water surface elevation of the lake at the end of the month. The average lake surface area can be taken as 5000 ha. Assume that there is no contribution to or from the ground water storage.

(b) *Sebuah tasik mempunyai paras permukaan air 103.2 m di atas datum pada awal suatu bulan yang tertentu. Dalam bulan tersebut tasik itu menerima purata aliran masuk 6.0 m³/s yang merupakan air larian permukaan dan aliran keluar 6.5m³/s. Pada bulan tersebut tasik itu menerima hujan sebanyak 145 mm dan anggaran penyejatan daripada permukaan tasik adalah 6.10 cm. Berikan persamaan keseimbangan air untuk tasik dan tentukan paras permukaan air tasik pada hujung bulan tersebut. Anggapkan tidak ada aliran air yang masuk dan keluar daripada storan air bumi. Gunakan keluasan permukaan tasik sebanyak 5000 ha.*

(6 marks)

- (c) For a drainage basin of 8160 km² isohyets drawn for a storm gave the following data. Estimate the average depth of the precipitation.

Isohyets (interval) (cm)	75-85	85-95	95-105	105-115	115-135	135-155
Inter-isohyetal area (km ²)	580	2960	2850	1000	610	160

(c) *Kawasan tadahan seluas 8160 km² mempunyai isohiet untuk suatu peristiwa ribut seperti di dalam jadual di bawah. Tentukan purata kedalaman hujan yang berlaku.*

Isohiet (jeda) (cm)	75-85	85-95	95-105	105-115	115-135	135-155
Luas Inter-Isohiet (km ²)	580	2960	2850	1000	610	160

(8 marks)

...3/-

2. (a) Name the various methods for estimating mean precipitation over an area.

(a) *Berikan beberapa kaedah untuk menganggarkan purata hujan untuk suatu kawasan.*

(4 marks)

(b) There are four rain gauge stations existing in the catchment of a river. The average annual rainfall values at these stations are 800, 620, 400, and 540 mm respectively. If it is desired to limit the error in the mean value of rainfall in the catchment to 10%, Determine:

- i. the optimum number of rain gauges for the catchment and
- ii. how many more rain gauges will be required to be installed?

(b) *Suatu kawasan tadahan mempunyai empat (4) tolok hujan dengan purata hujan tahunan adalah 800, 620, 400 dan 540 mm, masing-masing. Sekiranya had ralat maksima yang dibenarkan untuk purata hujan kawasan tadahan tersebut adalah 10%, tentukan perkara berikut:*

- i. *bilangan tolok hujan optima untuk kawasan tadahan tersebut.*
- ii. *bilangan tolok hujan tambahan yang perlu dipasang untuk kawasan tadahan tersebut.*

(8 marks)

(c) A reservoir with a surface area of 250 hectares had the following average values of parameters during a week: water temperature = 20°C, relative humidity 40%, wind velocity at 1.0 m above ground = 16 km/h. Estimate,

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

(c) *Suatu takungan dengan keluasan permukaan air 250 hektar mempunyai nilai purata parameter berikut dalam satu minggu: suhu air = 20°C, kelembapan bandingan 40%, halaju angin pada 1.0 m pada aras bumi = 16 km/h. Tentukan perkara berikut:*

- i. *purata penyejatan daripada takungan*
- ii. *isipadu air yang tersejat daripada takungan dalam tempoh satu minggu.*

(8 marks)

3. (a) Distinguish between the followings:

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

(a) *Terangkan perbezaan diantara perkara berikut:*

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

(6 marks)

...4/-

(b) A 30 cm diameter well completely penetrates an unconfined aquifer of saturated depth of 40m. After a long period of pumping at a steady rate of 1500 lpm, the drawdown in the two observation wells 25m and 75m from the pumping well were found to be 3.5m and 2.0m respectively.

- i. Determine the transmissivity of the aquifer
- ii. What is the drawdown at the pumping well?

(b) *Telaga bergaris pusat 30 cm menembusi akuifer tak-terkurung yang mempunyai kedalaman tepu setinggi 40 m. Pengepaman untuk jangka masa yang panjang dengan kadar mantap 1500 lpm mendapati surutan di dalam telaga pemerhatian yang terletak 25m dan 75m daripada telaga pengepaman adalah 3.5m dan 2.0m, masing-masing.*

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

(8 marks)

(c) At a certain point in an unconfined aquifer of 3 km² area, the water table was at an elevation of 102.00m. Due to a natural recharge in a wet season, its level rose to 103.20m. A volume of 1.5Mm³ of water was then pumped out of the aquifer causing the water table to reach a level of 101.20m. Assuming the water table in the entire aquifer to respond in a similar way, estimate:

- i. The specific yield of the aquifer
- ii. The volume of recharge during the wet season

(c) *Paras air bumi di dalam akuifer tak-terkurung dengan keluasan 3 km² pada satu titik tertentu adalah 102.00m. Paras air tersebut meningkat kepada 103.20m di sebabkan oleh imbuan semula jadi semasa musim lembap. Isipadu air sebanyak 1.5Mm³ dipam keluar daripada akuifer menyebabkan perubahan paras air bumi kepada 101.20m. Anggapkan paras air bumi di dalam akuifer tersebut mempunyai tindak balas yang sama, tentukan:*

- i. hasil tentu akuifer*
- ii. isipadu imbuan semasa musim lembap.*

(6 marks)

4. (a) Describe **FIVE (5)** factors which should be considered in the selection of stream flow gauging station.

(a) *Berikan LIMA (5) faktor yang perlu diambil kira dalam pemilihan stesen pengukuran kadar alir sungai.*

(5 marks)

(b) Briefly describe **THREE (3)** methods for measuring streamflow and factors which affect the selection of stream gauging method.

(b) *Terangkan secara ringkas TIGA (3) kaedah pengukuran kadaralir sungai dan nyatakan faktor yang menentukan pemilihan kaedah untuk menganggarkan kadaralir sungai.*

(5 marks)

(c) The data for streamflow gauging based on velocity-area method are given in the table below. The velocity is estimated using current meter taken at 0.6 of the depth at every point of measurement for all sub-sections. Estimate the streamflow using the river cross-section given in the table below.

(c) *Data pengukuran kadaralir sungai menggunakan kaedah halaju-luas dengan bacaan jangka arus diambil pada 0.6 kedalaman pada semua titik pengukuran diberikan dalam jadual di bawah. Menggunakan data yang diberikan tentukan kadaralir sungai tersebut.*

Distance from left water edge (m) Jarak (m) (drp tepiing kiri)	Depth (m) Kedalaman (m)	Velocity (m/s) Halaju (m/s)
4.0	0.00	
8.0	1.75	0.48
16.0	2.60	0.55
24.0	3.50	0.57
32.0	2.15	0.53
40.0	1.50	0.49
44.0	0.00	

(10 marks)

5. (a) Briefly describe the flow components which form the streamflow.

(a) *Terangkan secara ringkas komponen aliran yang terdapat di dalam kadaralir sungai.*

(5 marks)

(b) Calculate 2-hour and 3-hour unit hydrographs for a drainage basin from the given 1-hour unit hydrograph in the table below.

(b) *Hitung 2-jam dan 3-jam unit hidrograf untuk suatu kawasan tadahan sungai menggunakan 1-jam unit hidrograf yang diberikan di dalam jadual di bawah.*

Time (hr) Masa (jam)	0	1	2	3	4	5	6	7	8	9	10	11	12
1-hr UH ($m^3/s/cm$) 1-jam UH ($m^3/s/cm$)	0	100	175	350	650	720	690	550	410	325	150	110	0

(15 marks)

6. (a) Briefly define the term given by the return period (T) and exceedance probability. Given that an event x with return period (T) is denoted by x_T , determine the probability (in term of T) of occurrence (exceedance probability) $p = P(X \geq x_T)$ and the $(1-p) = P(X < x_T)$.

(a) Terangkan definisi untuk kala kembali (T) dan kebarangkalian dilampaui (exceedance probability). Untuk suatu peristiwa x dengan kala kembali T diwakili oleh x_T , berikan kebarangkalian (dalam bentuk T) untuk $p = P(X \geq x_T)$ dan $(1-p) = P(X < x_T)$.

(5 marks)

- (b) The mean annual flow and standard deviation at a riverflow gauging station are $5.30 m^3/s$ and $3.75 m^6/s^2$, respectively. Using normal distribution determine the following:

- the probability that mean annual flow will not be less than $8.5 m^3/s$.
- the 20-year return period mean annual flow at the riverflow gauging station.
- the probability that the mean annual flow will be less than $5 m^3/s$ in the next two consecutive years.

(b) Suatu stesen kadaralir sungai mempunyai purata tahunan sebanyak $5.30 m^3/s$ dan sisihan piawai $3.75 m^6/s^2$. Dengan menggunakan taburan normal, tentukan perkara berikut:

- kebarangkalian purata tahunan tidak akan kurang daripada $8.5 m^3/s$.
- magnitud purata aliran tahunan dengan kala kembali 20-tahun.
- kebarangkalian purata aliran tahunan akan kurang dari $5 m^3/s$ untuk 2 tahun berturut-turut.

(15 marks)

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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

continued

33

LAMPIRAN

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