UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2011/2012

COURSE NAME	:	HYDROLOGY
COURSE CODE	:	BFC 3092 / BFC 32002
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	JANUARY 2012
DURATION	:	2 ½ HOURS
INSTRUCTION	:	**ANSWER QUESTION 1** IN **PART A** AND **ANY THREE (3)** IN **PART B**

THIS PAPER CONSISTS OF **EIGHTEEN (18)** PAGES

PART A
ANSWER QUESTION 1

Q1 (a) What is the difference between artesian and water table aquifer.

(5 marks)

(b) The soil under the dam consists of four layers as shown in **Figure Q1 (Appendix I)**. Calculate the average conductivity (m/day) and transmissivity (m^2/day) of the soil when water table is at the ground surface.

(12 marks)

(c) A fully penetrating 12 cm diameter well has its bottom 80 meter below the static ground water table. After 24 hours of pumping at 1100 m^3/min, the water level in the test well stabilizes to 10 meter below the static water table. A draw-down of 3.65 meter is noticed in an observation (test) well 300 meters away from the pumped well. Determine the hydraulic conductivity of the aquifer in m/s.

(8 marks)

PART B
*ANSWER **ANY THREE (3)** QUESTIONS*

Q2 (a) What do you understand about water balance equation.

(5 marks)

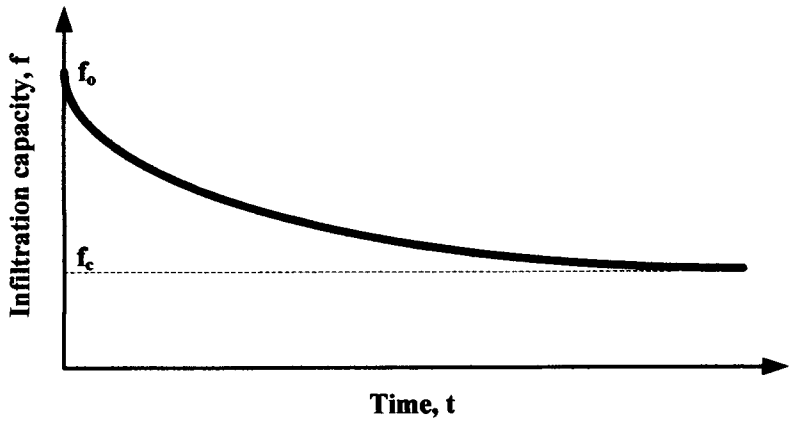
(b) Gauge *X* was installed in January 1967 and removed from its original location in January 1962. Adjust the record as in **Table Q2** for the period from 1958 to 1962 using the records at gauges *P*, *Q* and *R*. Plot cumulative precipitation for station *X* versus cumulative precipitation of base stations.

Table Q2

Year	Annual rainfall (cm)			
	P	*Q*	*R*	*X*
1958	54	50	56	50
1959	60	60	66	58
1960	64	58	70	60
1961	68	66	74	62
1962	58	58	60	52
1963	56	52	54	60
1964	64	68	68	72
1965	70	68	72	76
1966	62	58	68	72
1967	56	54	58	62

(20 marks)

Q3 (a) What do you understand about the following figure.



(5 marks)

(b) An isolated storm produced surface runoff volume of 17500 m^3 over 50 hectares catchment area. The cumulative rainfall over the catchment is shown in **Table Q3**. Sketch the hyetograph and calculate the Φ index for the storm in cm/hr.

Table Q3

Time (minute)	Cumulative rainfall (cm)
0	0
30	0.5
60	1.65
90	3.55
120	3.55
150	4.70
180	6.80
210	7.95
240	8.45

(20 marks)

Q4 (a) Discuss how land cover and use affect the runoff characteristics of a watershed.
(5 marks)

(b) Compute the peak runoff Q_p for a 10-year storm using rational method for a drainage basin of 8 hectares and having the following parameters as shown in **Table Q3 (a)** and **Table Q3 (b)** :-

Table Q3 (a)

Drainage Type	Parameters		
	Surface	Length	Slope
Overland flow	Average grass surface	80 m	3.5 %
Shallow concentrated flow	Unpaved	160 m	4.0 %
Stream flow	-	250 m	0.2 %

Table Q3 (b)

Character of surface	Area
Asphalt and concrete	0.5 hectares
Residential (suburban)	3.0 hectares
Unimproved	4.5 hectares

The average cross section of the stream and the related figures are illustrated in **Figure Q3 (a) to Figure Q3 (d) (Appendix II to V).**
(20 marks)

Q5 (a) What is Unit Hydrograph (UH). State **FOUR (4)** application of UH in engineering hydrology.
(5 marks)

(b) A 6.50×10^8 m^2 natural catchment having characteristics as illustrated in **Figure Q4 (Appendix V).** Derive and sketch 2-hour unit hydrograph in graphical view using Soil Conservation Service (SCS) method. Assume that $C_t = 2.2$ and $C_p = 0.7$
(20 marks)

Q6 (a) State the relationship that should be known for routing a hydrograph through a reservoir or detention structure.

(2 marks)

(b) The surface storage facility is used to control runoff from a residential area where the outflow from the basin is controlled by a weir. The reservoir routing curves is shown in **Figure Q5 (Appendix VI)**. Using the puls method, derive the outflow hydrograph from the inflow as listed in Table Q5. Sketch the inflow and outflow hydrographs.

Table Q5

Time (min)	0	15	30	45	60	75	90	105	120	135	150
Inflow (m^3/s)	0	10	25	40	55	50	35	25	15	10	5

(23 marks)

BAHAGIAN A
JAWAB SOALAN 1

S1 (a) Apakah perbezaan di antara akuifer artesian dan air bumi.

(5 markah)

(b) Tanah di bawah empangan mengandungi empat lapisan seperti ditunjukkan di dalam **Rajah S1 (Lampiran I)**. Kirakan purata kebolehtelapan (m/hari) dan keberaliran (m^2/hari) tanah apabila paras air bumi berada pada permukaan tanah.

(12 markah)

(c) Sebuah telaga berdiameter 12 cm dan hujung 80 m tertusuk sepenuhnya di bawah paras air bumi statik. Setelah 24 jam pengepaman pada kadar 1100 m^3/min, paras air di dalam telaga ujian menjadi stabil kepada 10 m di bawah paras air bumi statik. Suatu susutan sebanyak 3.65 m diperhatikan di dalam sebuah pemerhatian (ujian) 300 m jaraknya daripada telaga pengepaman. Tentukan kebolehtelapan hidraulik akuifer ini dalam m/s.

(8 markah)

BAHAGIAN B
*JAWAB **MANA-MANA TIGA (3)** SOALAN*

S2 (a) Apa yang anda faham mengenai persamaan keseimbangan air.

(5 markah)

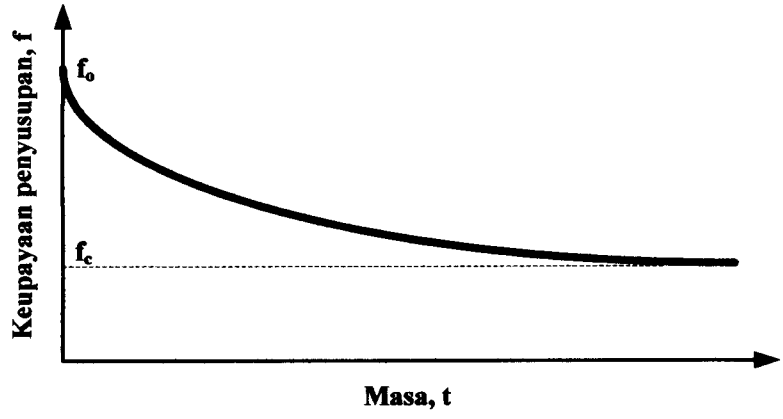
(b) Tolok *X* telah dipasang pada Januari 1967 dan telah dialihkan daripada lokasi asalnya pada Januari 1962. Laraskan rekod ini seperti di dalam **Jadual S2** dari tahun 1958 hingga 1962 menggunakan rekod-rekod pada tolok *P*, *Q* dan *R*. Plot hujan kumulatif untuk stesen *X* melawan hujan kumulatif stesen-stesen rujukan.

Jadual S2

Tahun	Hujan tahunan (cm)			
	P	*Q*	*R*	*X*
1958	54	50	56	50
1959	60	60	66	58
1960	64	58	70	60
1961	68	66	74	62
1962	58	58	60	52
1963	56	52	54	60
1964	64	68	68	72
1965	70	68	72	76
1966	62	58	68	72
1967	56	54	58	62

(20 markah)

S3 (a) Apa yang anda faham mengenai rajah berikut.



(5 markah)

(b) Satu ribut yang terasing menghasilkan isipadu air larian permukaan sebanyak 17500 m^3 di atas kawasan tadahan 50 hektar. Hujan kumulatif di atas tadahan ini ditunjukkan dalam **Jadual S3**. Lakarkan hitograf dan kira index Φ bagi ribut ini dalam unit cm/j.

Jadual S3

Masa (minit)	Hujan kumulatif (cm)
0	0
30	0.5
60	1.65
90	3.55
120	3.55
150	4.70
180	6.80
210	7.95
240	8.45

(20 markah)

S4 (a) Bincangkan bagaimana permukaan dan kegunaan tanah mempengaruhi ciri-ciri air larian permukaan sesebuah kawasan tadahan.

(5 markah)

(b) Kira kadar alir puncak Q_p, untuk ribut 10 tahun menggunakan kaedah rasional untuk sebuah kawasan tadahan 8 hektar dan mempunyai parameter-parameter berikut seperti ditunjukkan dalam **Jadual S3 (a)** dan **Jadual S3 (b)** :-

Jadual S3 (a)

Jenis Saliran	Parameter-parameter		
	Permukaan	Panjang	Cerun
Aliran atas tanah	Permukaan rumput purata	80 m	3.5 %
Aliran tumpuan cetek	Tidak berturap	160 m	4.0 %
Aliran sungai	-	250 m	0.2 %

Jadual S3 (b)

	Ciri permukaan	Luas
C_1 0.95	Asfalt dan konkrit	0.5 hektar
C_2 0.40	Perumahan (sub-bandar)	3.0 hektar
C_3 = 0.30	Tidak dibangunkan	4.5 hektar

Keratan rentas purata sungai ini dan rajah berkaitan digambarkan dalam **Rajah S3 (a)** hingga **Rajah S3 (d)** **(Lampiran II** hingga **V).**

(20 markah)

S5 (a) Apakah Hidrograf Unit (UH). Nyatakan **EMPAT (4)** kegunaan UH dalam bidang kejuruteraan hidrologi.

(5 markah)

(b) Sebuah kawasan tadahan asli seluas 6.50×10^8 m^2 mempunyai ciri-ciri seperti ditunjukkan di dalam **Rajah S4 (Lampiran V).** Terbitkan dan lakarkan hidrograf unit 2-jam secara gambaran grafik menggunakan kaedah *Soil Conservation Service* (SCS). Anggap $C_t = 2.2$ dan $C_p = 0.7$.

(20 markah)

S6 (a) Nyatakan hubungan yang perlu diketahui untuk penghalaan hidrograf menerusi sebuah takungan atau struktur tahanan.

(2 markah)

(b) Sebuah kemudahan simpanan permukaan digunakan untuk mengawal air larian permukaan daripada sebuah kawasan perumahan di mana aliran keluar daripada tadahan dikawal oleh sebuah empang. Lengkung penghalaan takungan ditunjukkan di dalam **Rajah S5 (Lampiran VI)**. Menggunakan kaedah *puls*, terbitkan hidrograf kadar alir keluar daripada kadar alir masuk seperti yang tersenarai di dalam Jadual S5. Lakarkan hidrograf-hidrograf aliran masuk dan keluar.

Jadual S5

Masa (min)	0	15	30	45	60	75	90	105	120	135	150
Kadar alir masuk (m^3/s)	0	10	25	40	55	50	35	25	15	10	5

(23 markah)

APPENDIX 1

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2011/2012 PROGRAMME : 3 BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC 3092 / BFC 32002

TABLE

Table Q4 : Table of ratios for the SCS dimensionless unit hydrograph

Time Ratio (*t*/*Pr*)	Hydrograph Discharge Ratio (*Q*/*Qp*)	Time Ratio (*t*/*Pr*)	Hydrograph Discharge Ratio (*Q*/*Qp*)
0	0	1.5	0.66
0.1	0.015	1.6	0.56
0.2	0.075	1.8	0.42
0.3	0.16	2.0	0.32
0.4	0.28	2.2	0.24
0.5	0.43	2.4	0.18
0.6	0.60	2.6	0.13
0.7	0.77	2.8	0.098
0.8	0.89	3.0	0.075
0.9	0.97	3.5	0.036
1.0	1.00	4.0	0.018
1.1	0.98	4.5	0.009
1.2	0.92	5.0	0.004
1.3	0.84	Infinity	0
1.4	0.75		

FIGURE

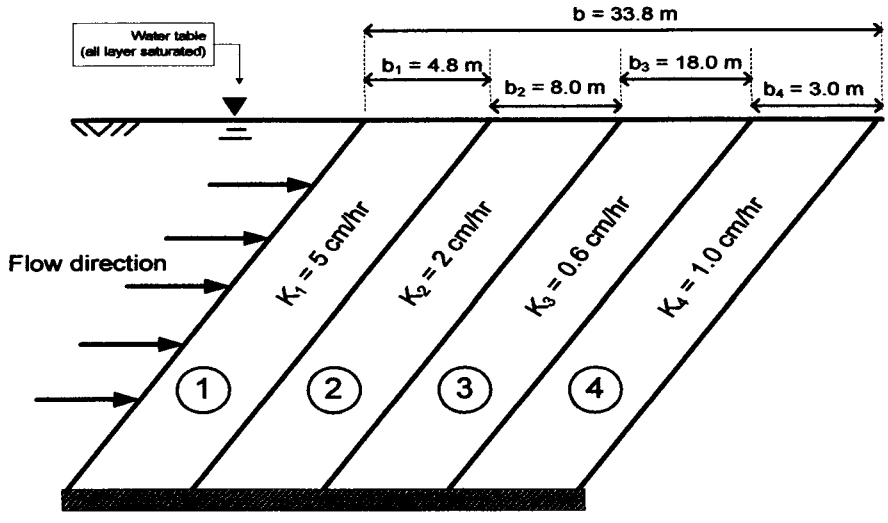


Figure Q1 : Layer of soils

APPENDIX 1I

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2011/2012 PROGRAMME : 3 BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC 3092 / BFC 32002

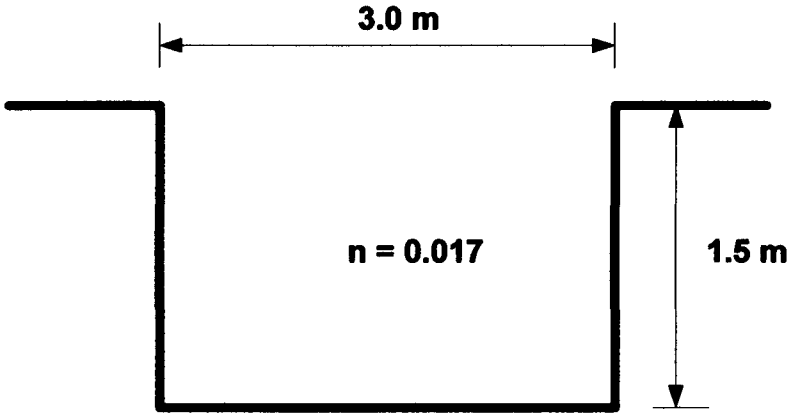


Figure Q3 (a) : Average cross section of stream

APPENDIX 1II

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2011/2012 PROGRAMME : 3 BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC 3092 / BFC 32002

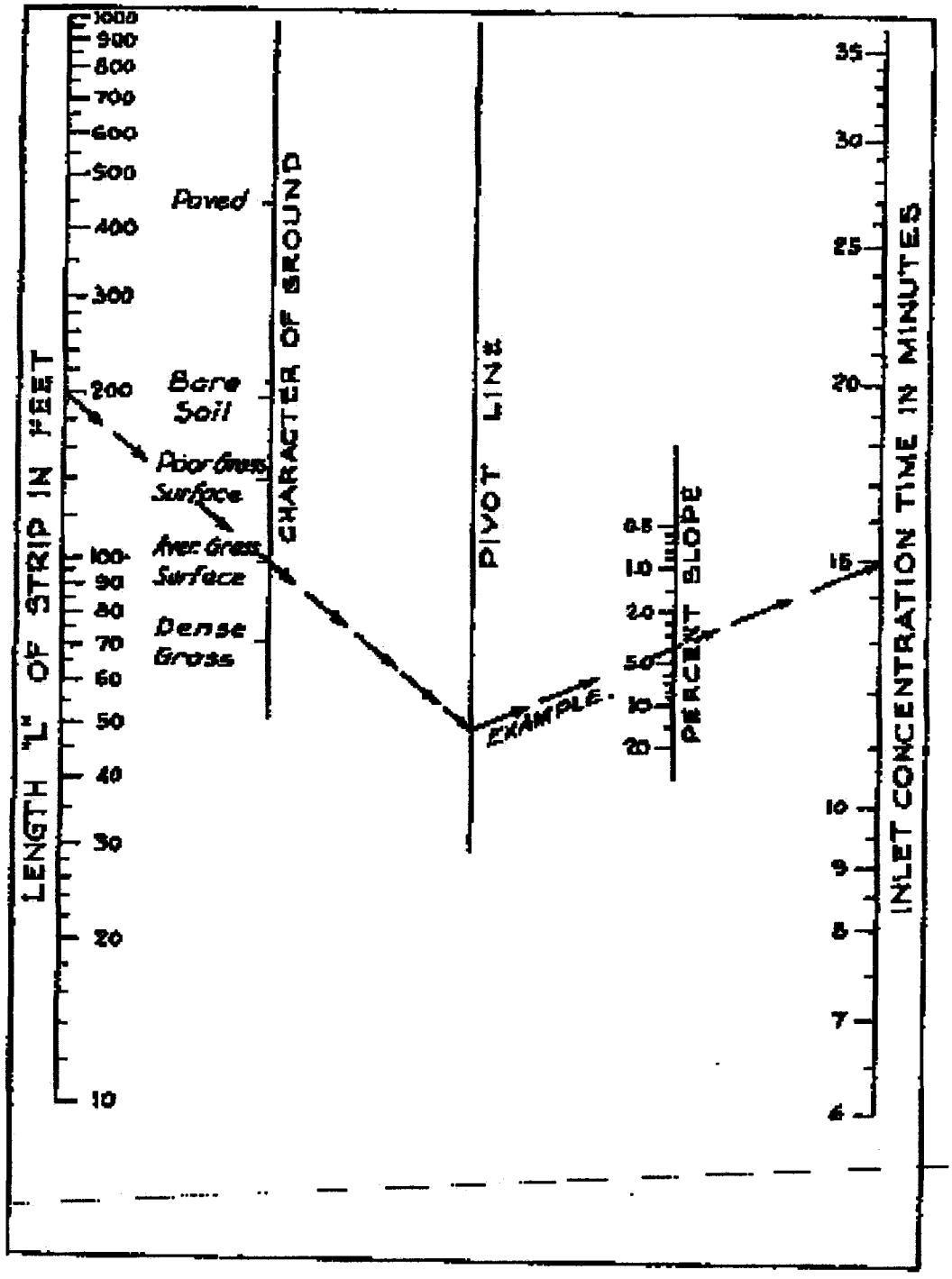


Figure Q3 (b) : Nomograph for overland flow time

APPENDIX 1V

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2011/2012 PROGRAMME : 3 BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC 3092 / BFC 32002

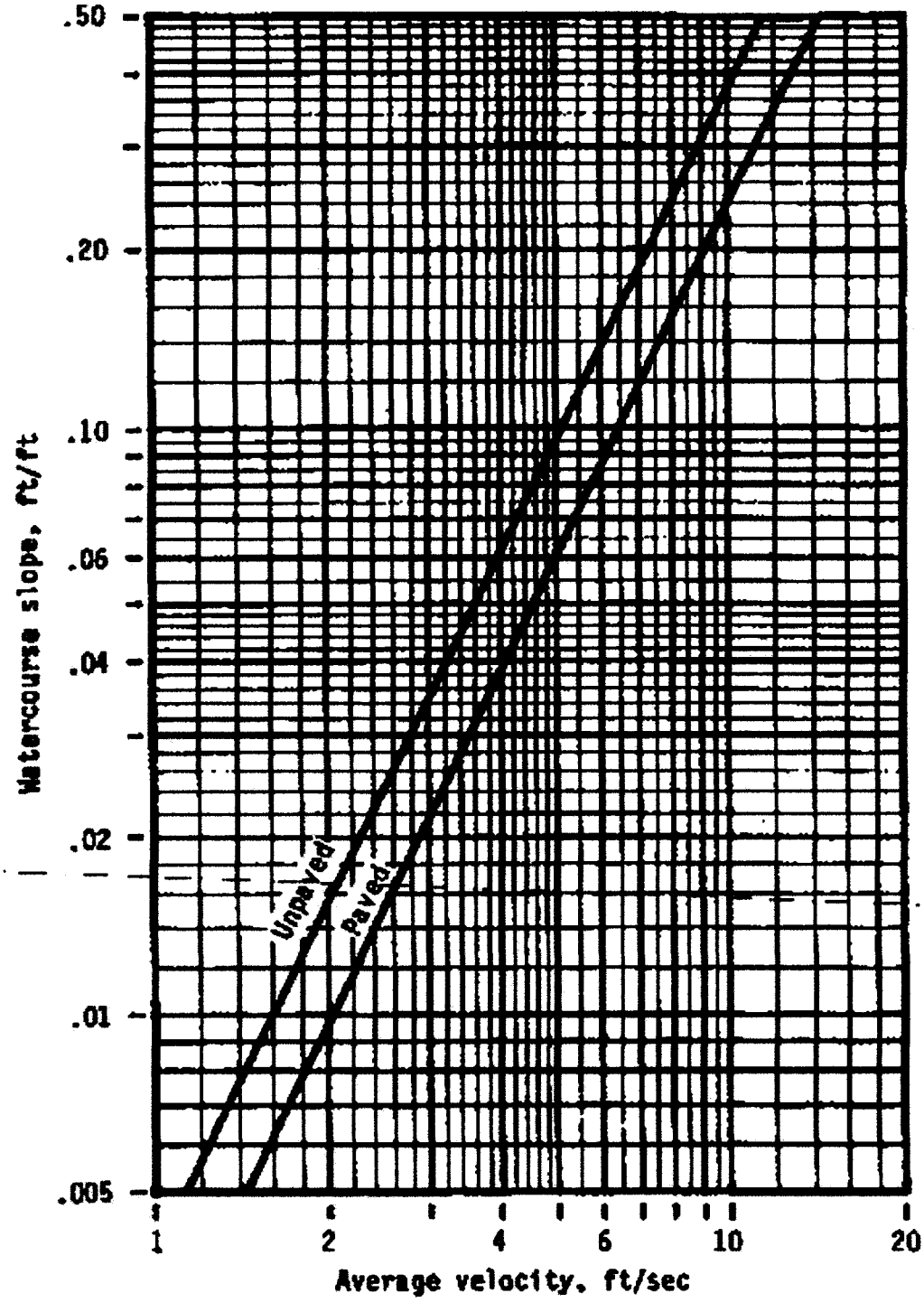


Figure Q3 (c) : Average velocities for estimating travel time for shallow concentrated flow

APPENDIX V

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2011/2012 PROGRAMME : 3 BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC 3092 / BFC 32002

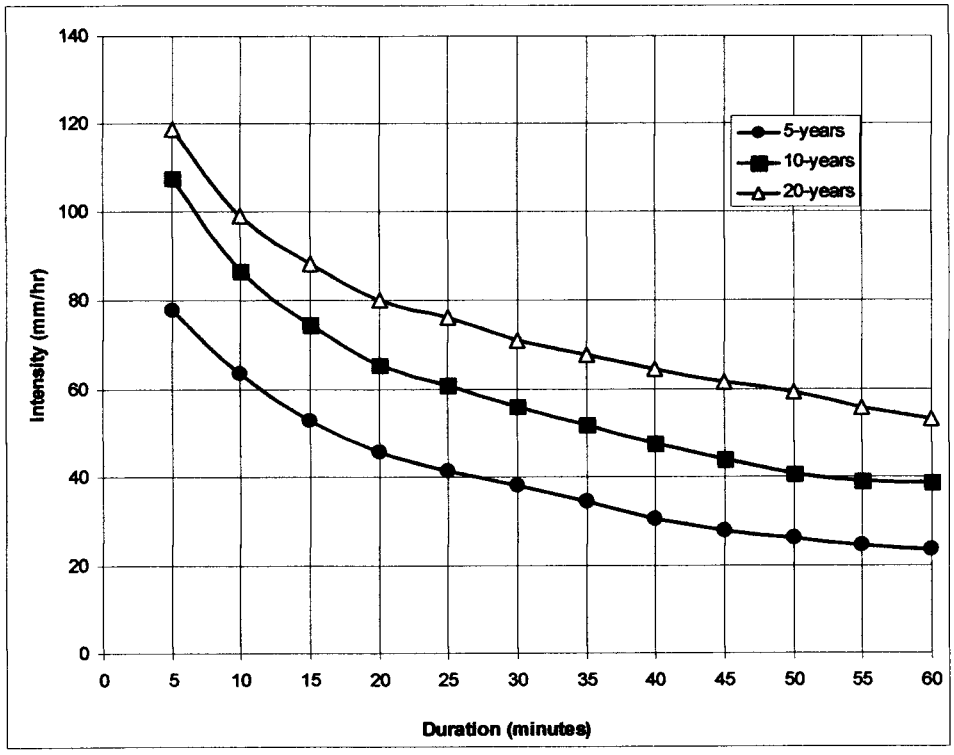


Figure Q3 (d) : Intensity-Duration-Frequency (IDF) curve

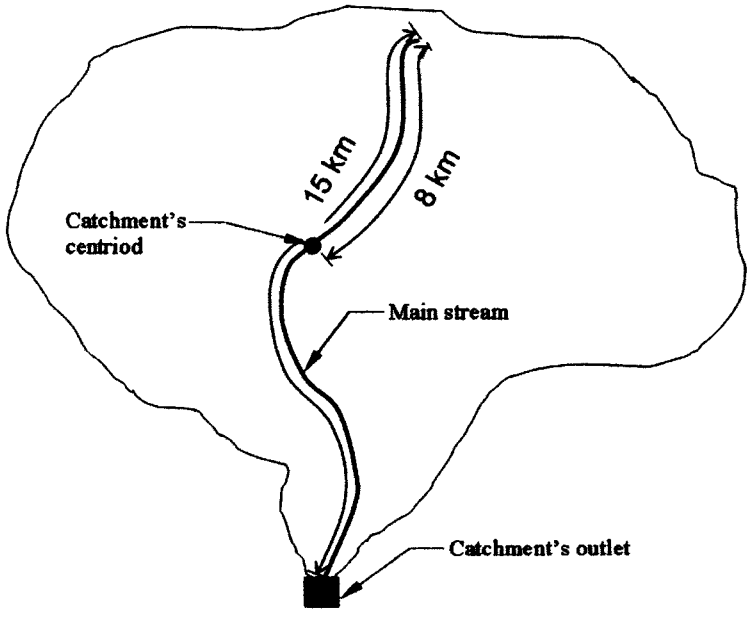


Figure Q4 : Characteristics catchment for SCS method

APPENDIX VI

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2011/2012 PROGRAMME : 3 BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC 3092 / BFC 32002

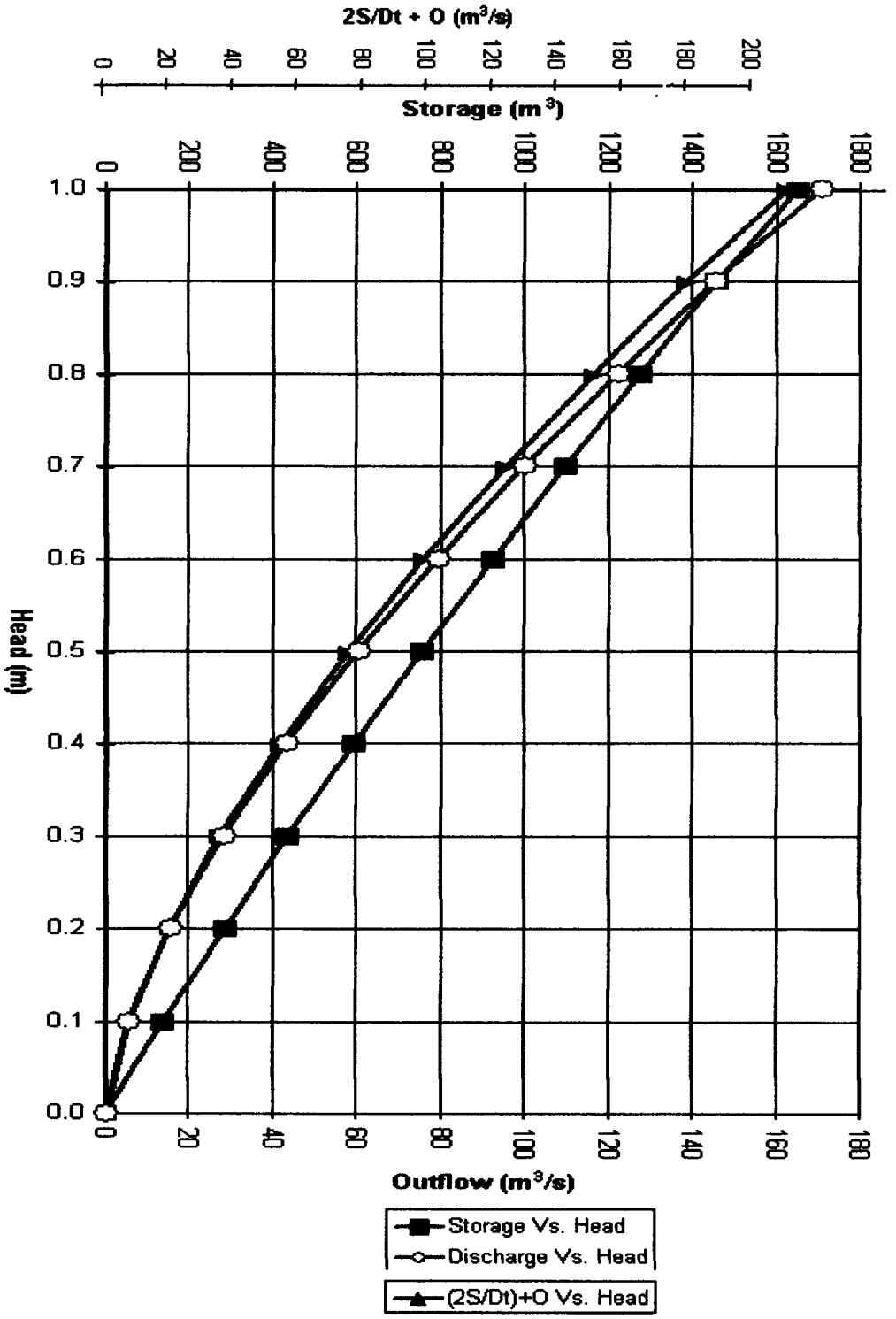


Figure Q5 : Reservoir rating curves

APPENDIX VII

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2011/2012 PROGRAMME : 3 BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC 3092 / BFC 32002

EQUATIONS

$$Q_p = \frac{0.208A}{P_r} \qquad t_p = C_t(LL_C)^{0.3} \qquad P_r = \frac{t_r}{2} + t_p$$

$$(I_1 + I_2) + \left(\frac{2S_1}{\Delta t} - O_1\right) = \left(\frac{2S_2}{\Delta t} + O_2\right) \qquad Q = \frac{iCA}{360}$$

$$Q = \frac{1}{n} AR^{2/3}\sqrt{S_o} \qquad \Phi = \frac{P-R}{t_e}$$

$$\overline{K} = \frac{b}{\left(\frac{b_1}{K_1}\right) + \left(\frac{b_2}{K_2}\right) + \left(\frac{b_3}{K_3}\right) + ...\left(\frac{b_n}{K_n}\right)} \qquad \overline{K} = \frac{K_1b_1 + K_2b_2 + K_3b_3 + ...K_nb_n}{b}$$

$$H^2 - h^2 = \frac{Q}{\pi K}\ln\frac{R}{r} \qquad H - h = \frac{Q}{2\pi bK}\ln\frac{R}{r}$$