UNIVERSITY OF JOHANNESBURG

Program	:	NATIONAL DIPLOMA : ENGINEERING : CIVIL
Subject	:	HYDROLOGY 3B
Code	:	*(CEW3B21)*
Assessment	:	YEAR – END EXAMINATION
Date	:	24 November 2017
Duration	:	(SESSION 1) 08:30 - 11:30
Weight	:	40: 60
Total Marks	:	100
Examiner	:	D.T Chabalala
Moderator	:	Mr. N.L Baloyi
Number of pages	:	Pages: 8 including the cover page and annexures.
Instructions	:	THIS IS AN OPEN BOOK EXAMINATION
	:	Flood Hydrology by Haarhoff and Cassa **only** may be brought into examination venue.

1. This paper contains 7 questions
2. PLEASE ANSWER **ALL** QUESTIONS
3. Any additional material is to be placed in the answer book and must indicate clearly the question number, your name, and Student number.

QUESTION 1

[25]

A catchment in Kibler Park, Johannesburg (MAP = 760 mm/year) subdivision contributes drainage from segment shown in Figure 1.1. Each of the five homes has a direct connected impervious area of 3. 200 m^2, which drains to the street. The street drains to the two inlets indicated. Lawns are on "sandy soil on steep slope." A 10 year design standard is appropriate for residential subdivisions and streets. Runoff coefficients should be taken at the "high" end of the ranges (see Table 1.1). Inlets times are 8 min for the impervious area of the subdivision and 20 min for the total area (impervious plus lawn). By using Rational method, what is the design flow at the inlets (treated as one inlets)?

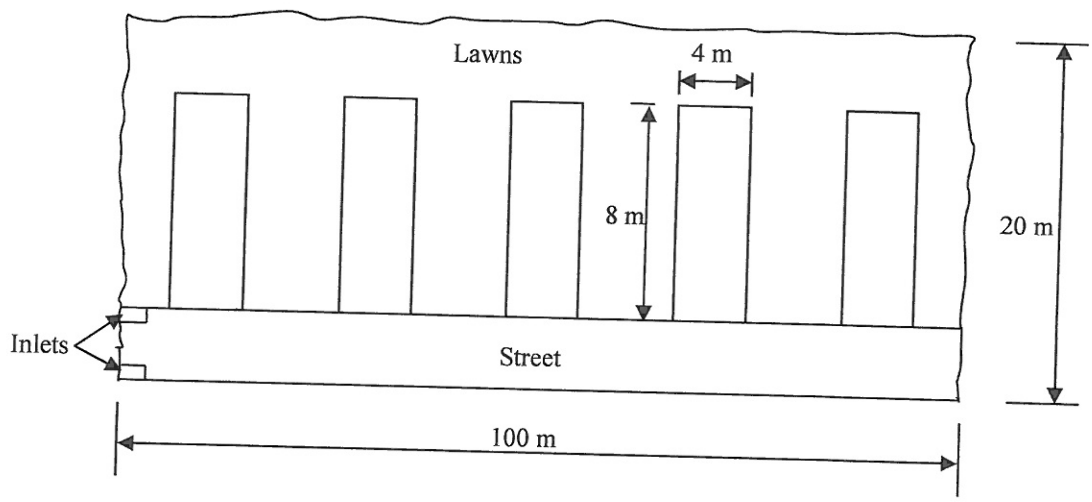

Figure 1.1

QUESTION 2

[15]

A catchment has a system of seven rainfall gages, as shown on the map in Figure 2.1. Using the total storm rainfall depth given in the accompanying table, determine the average rainfall over the catchment area using (a) Arithmetic averaging and (b) the Thiessen Polygon Method. It is estimated that each grid cell represents 1 Km^2 of area.

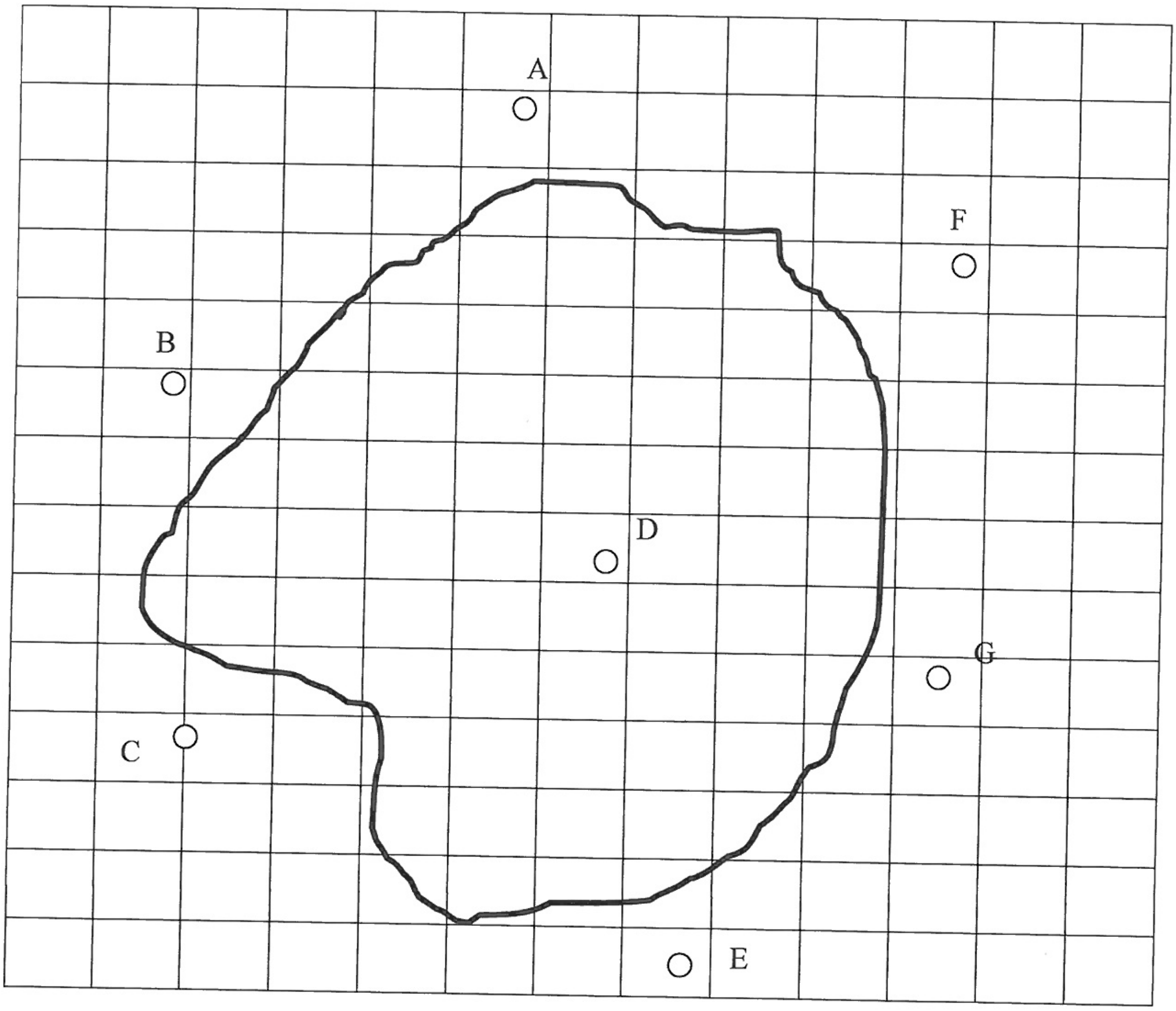

Fig. 2.1

Gage	A	B	C	D	E	F	G
Rainfall (mm)	610	550	600	615	594	580	620

QUESTION 3 [15]

Drainage area within each of the Isohyetal lines for a storm are tabulated for a catchment.

a) Use the Isohyetal method to determine the average precipitation depth within the catchment for the storm.

Isohyetal intervals (m)	**Area (Km^2)**
0 - 2	27
2 – 4	19
4 - 6	10
6 - 8	5

b) Discuss how you would go about collecting data for analysis of the rainfall of the region. What agencies would you contacts? What other sources of information would you seek out?

QUESTION 4 [15]

Given the following 2-hr unit hydrograph, use S-hydrograph procedures to construct a 3-hr unit hydrograph.

Time (hr)	0	1	2	3	4	5	6
Flow (m^3/s)	0	100	250	200	100	50	0

QUESTION 5 **[10]**

Using the annual discharge for Jukskei River in Johannesburg (see data in Table 5.1), estimate the return periods of the highest ten values using the Gringorten method.

QUESTION 6 **[5]**

What return period must be highway engineer use in designing a critical underpass drain to accept only a 10 percent risk that flooding will occur in the next 5 years?

QUESTION 7 **[15]**

Use the following inflow hydrograph:

Time	Inflow (m^3/s)	Outflow (m^3/s)
6 a.m	10	10
Noon	30	
6 p.m	68	
Midnight	50	
6 a.m	40	
Noon	31	
6 p.m	23	
Midnight	10	

Compute the outflow hydrograph by the Muskingum method using values of K = 11 hr and X = 0.13.

Table 5.1

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Total Volume
1905/1906	0.16	11.70	113.00	14.30	51.90	12.90	2.46	2.87	3.92	3.84	3.15	2.15	**222.35**
1906/1907	30.00	86.90	49.20	152.00	225.00	89.30	55.50	12.70	5.79	4.52	2.85	1.74	**715.50**
1907/1908	17.00	129.00	133.00	29.20	30.20	3.85	12.40	2.75	2.46	2.80	1.89	0.98	**365.53**
1908/1909	9.81	56.80	30.60	34.90	102.37	35.35	23.45	6.11	4.06	3.72	2.63	1.62	311.42
1909/1910	8.03	93.90	119.00	86.20	143.00	138.00	12.00	5.95	5.53	5.41	2.64	3.98	**623.64**
1910/1911	64.90	75.66	88.96	63.32	110.49	55.88	21.16	6.08	4.35	4.06	2.63	2.10	**499.59**
1911/1912	35.00	28.10	47.80	20.80	73.50	55.88	21.16	6.08	4.35	4.06	2.63	2.10	**301.46**
1912/1913	0.21	7.06	35.80	67.90	41.80	31.20	29.90	4.17	2.15	1.98	2.20	0.45	**224.82**
1913/1914	26.50	7.69	13.40	34.00	4.66	12.00	5.25	2.16	1.95	0.97	0.68	0.30	**109.56**
1914/1915	8.40	11.60	119.00	86.20	143.00	138.00	12.00	5.95	5.53	5.41	2.64	3.98	**541.71**
1915/1916	4.49	49.30	88.96	63.32	110.49	55.88	21.16	6.08	4.35	4.06	2.63	2.10	**412.82**
1916/1917	0.00	10.10	47.80	20.80	73.50	55.88	21.16	6.08	4.35	4.06	2.63	2.10	**248.46**
1917/1918	86.00		35.80	67.90	41.80	31.20	29.90	4.17	2.15	1.98	2.20	0.45	**303.55**
1918/1919	34.40	11.80	13.40	34.00	4.66	12.00	5.25	2.16	1.95	0.97	0.68	0.30	**121.57**
1919/1920	0.41	18.10	42.30	92.00	44.80	45.60	12.20	4.31	3.21	2.37	1.89	1.07	**268.26**
1920/1921	76.60	79.30	2.86	29.90	45.80	2.79	7.95	0.94	0.39	2.36	0.77	0.11	**249.77**
1921/1922	9.72	63.70	8.00	30.10	35.00	19.50	2.32	2.17	1.07	0.52	0.33	0.55	**172.98**
1922/1923	53.40		21.30	16.30	13.20	6.95	1.50	0.18	0.00	0.00	0.03	0.00	**112.87**
1923/1924	0.16	1.79	10.10	32.40	26.80	75.50	30.80	5.46	2.46	2.04	1.58	1.42	**190.51**
1924/1925	8.79	77.20	89.10	48.20	23.60	112.00	93.00	49.40	31.20	29.90	4.17	2.15	**568.71**
1925/1926	21.90	28.20	8.14	6.56	20.20	7.55	2.61	1.91	1.97	1.02	0.63	14.40	**115.09**
1926/1927	1.95	1.76	17.00	18.30	40.60	31.20	29.90	4.17	2.15	1.98	2.20	0.45	**151.66**
1927/1928	37.40	22.50	25.10	75.30	17.70	49.30	5.03	2.05	1.18	0.97	1.02	1.26	**238.81**
1928/1929	0.63	2.87	39.30	57.60	30.60	67.90	41.80	31.20	29.90	4.17	2.15	1.98	**310.10**
1929/1930	57.90	20.10	33.00	32.40	26.80	75.50	30.80	5.46	2.46	2.04	1.58	1.42	**289.46**
1930/1931	0.63	4.25	2.86	29.90	45.80	2.79	7.95	0.94	0.39	2.36	0.77	0.11	**98.75**
1931/1932	0.00	15.70	8.00	30.10	35.00	19.50	2.32	2.17	1.07	0.52	0.33	0.55	**115.26**
1932/1933	5.72	17.30	21.30	16.30	13.20	6.95	1.50	0.18	0.00	0.00	0.03	0.00	**82.49**
1933/1934	1.17	52.80	78.90	67.90	41.80	31.20	29.90	4.17	2.15	1.98	2.20	0.45	**314.62**
1934/1935	2.36	53.00	139.00	50.80	34.80	48.50	7.53	3.40	2.29	1.99	1.31	0.97	**345.95**

TABLE 1.1: SHOWING RUNOFF COEFFICIENT, C.

RURAL C_1					URBAN C_2	
COMPONENTS	**CLASSIFICATION**	**MEAN ANNUAL RAINFALL, MAP, (mm)**			**USE**	**FACTOR**
		500 - 600	**600 - 800**	**800 - 900**		
SURFACE SLOPE (C_h)	VLEI'S AND PANS (< 3 %)	0.01	0.03	0.05	**LAWNS**	
	FLAT AREAS (3 to 10 %)	0.06	0.08	0.11	SANDY, FLAT (< 2 %)	0.05 - 0.10
	HILLY (10 to 30 %)	0.12	0.16	0.20	SANDY, STEEP (> 7 %)	0.15 - 0.20
	STEEP AREAS (> 30 %)	0.22	0.26	0.30	HEAVY SOILS, FLAT (<2)	0.13 - 0.17
					HEAVY SOILS, STEEP (>7%)	0.25 - 0.35
PERMEBILITY (C_d)	VERY PERMEABLE	0.03	0.04	0.05		
	PERMEABLE	0.06	0.08	0.10	**RESIDENTIAL AREAS**	
	SEMI – PERMEABLE	0.12	0.16	0.20	HOUSES	0.30 – 0.50
	IMPERMEABLE	0.21	0.26	0.30	FLATS	0.50 – 0.70
VEGETATION (C_p)	THICK BUSH AND PLANTATION	0.03	0.04	0.05	**INDUSTRY**	
	LIGHT BUSH AND FARM LANDS	0.07	0.11	0.15	LIGHT INDUSTRY	0.50 – 0.80
	GRASS-LANDS	0.17	0.21	0.25	HEAVY INDUSTRY	0.60 – 0.90
	NO VEGETATION	0.26	0.28	0.30	**BUSINESS**	
					SUBURBAN	0.50 – 0.70
					CITY CENTRE	0.70 – 0.95
					STREETS	0.70 – 0.95
					MAXIMUM FLOOD	1.00

Surname & Initials: ……………………………………………………………………..

Student Number: ……………………………………………………………………

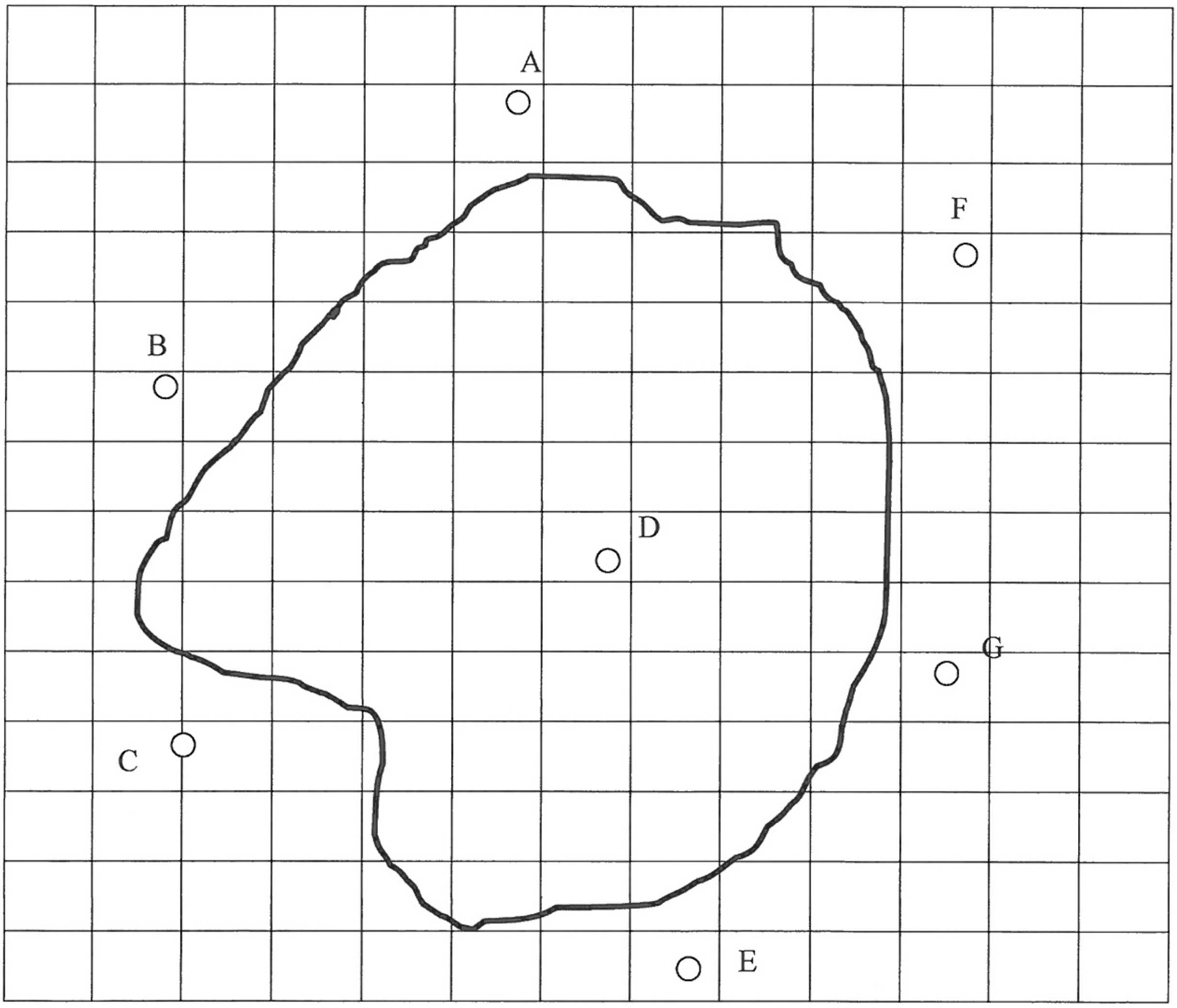

Fig. 2.1