PROGRAM	:	BACCALAUREUS INGENERIAE *CIVIL ENGINEERING*
SUBJECT	:	URBAN HYDRAULICS 4A
CODE	:	SDI 4A11 / SDICIA4
DATE	:	MAIN EXAMINATION MAY/JUNE 2019
DURATION	:	3 HOURS
WEIGHT	:	50 : 50
TOTAL MARKS	:	100

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MODERATOR	:	PROF. JM NDAMBUKI
NUMBER OF PAGES	:	4 PAGES

INSTRUCTIONS	:	ANSWER ALL QUESTIONS
REQUIREMENTS	:	POCKET CALCULATOR

Question One (ELO 2) (25 marks)

Pipeline AD is connected to a transmission main with a guaranteed pressure of at least 45 mwc. The data in Table 1 is valid.

Table 1

Section		AB	BC	CD
Ground level (masl)	Node A = 0	Node B = 0	Node C = 9	Node D = 2
Total number of dwellings along section		140	210	250
Section length (km)		5	8	12

Per capita water demand = 100 l/d

Average occupancy per dwelling = 4 persons

Fire fighting demand = 20 m^3/hr (to be added to each section)

Assume no head losses

a. What is the most favourable location for the fire fighting demand?
b. Calculate the design flow rates in the various distribution sections
c. Calculate the maximum pressure loss over distance AD
d. Calculate the maximum pressure gradient over distance AD
e. Determine the pressures of water in the pipe at points B, C and D
f. Plot the pressure line from points A to D relative to the ground.

Question Two (ELO 3) (25 marks)

A sewer is to be designed to convey a design flow rate of 2160 m^3/day. The slope of the sewer is limited to 1: 130. Considering Manning's n = 0.013:

a. Determine the diameter of a suitable sewer pipe to be installed, rounded up to the nearest 50 mm. No adequacy checks are required. (8 marks)
b. The same pipe designed in (a) above is to be laid in a 1854 ha area whose population density is 6 persons/ha, with a maximum per capita waste water production of 116.5 l/day. Neglect infiltration. You are required to:
    i. Determine the expected actual velocity in the sewer pipe (10 marks)
    ii. Does this velocity fall within an acceptable range? (3 marks)
    iii. Indicate why a velocity outside the range may be problematic. (4 marks)

Question Three **(35 marks)**

A storm drain system is laid out as presented in Fig. 1 with the characteristics given in Table 2. You are required to compute the design flow and the required pipe diameter for each reach of the system for a 10 year storm. Take Manning's n as 0.013. 1 ha = 10 000 m^2.

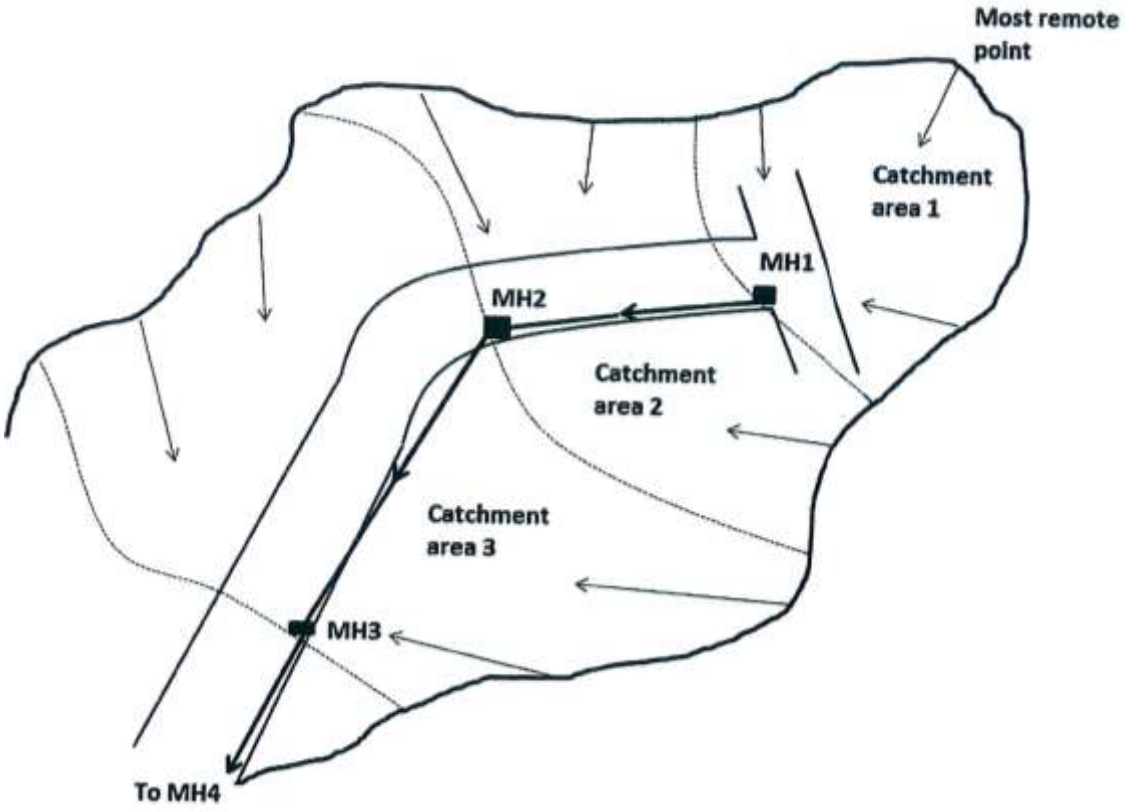


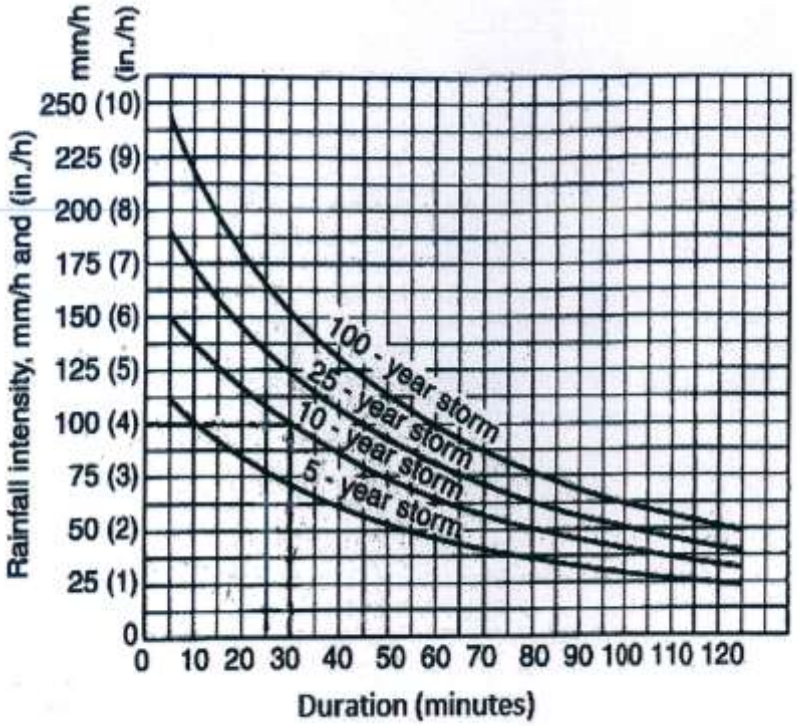
Table 2

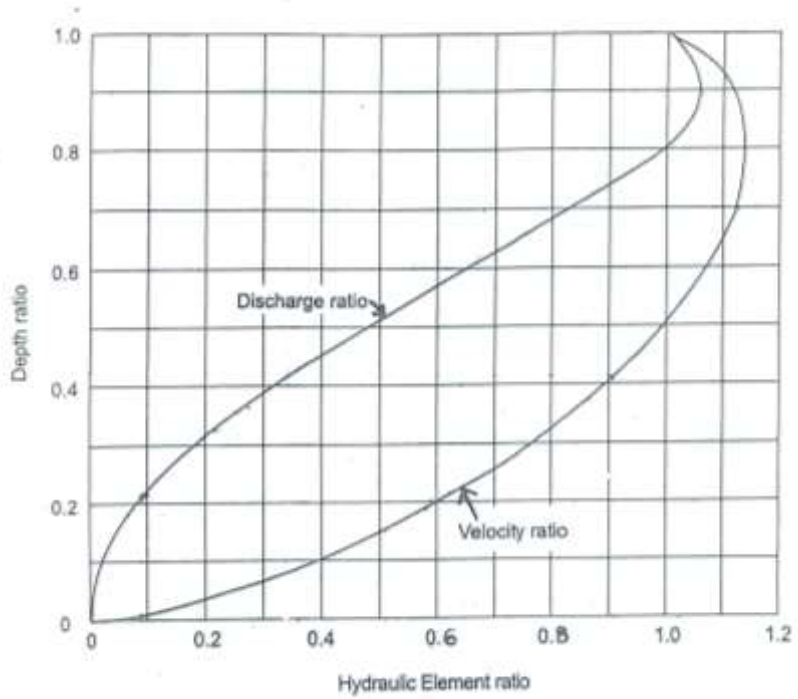
Catchment area	Area (ha)	Runoff coefficient - C	Inlet time (min)
1	A_1 = 1.5	C_1 = 0.50	6
2	A_2 = 2.5	C_2 = 0.40	10
3	A_3 = 3.2	C_3 = 0.30	8
Reach characteristics			
Reach	1	2	3
Length (m)	120	150	-
Slope (%)	0.4	0.3	0.3

Question Four **(15 marks)**

Write short notes on

a. Biochemical Oxygen Demand (4 marks)
b. Eutrophication (4 marks)
c. Crown corrosion (4 marks)
d. Energy generation from waste water treatment (3 marks)


mm/h
(in./h)
Rainfall intensity, mm/h and (in./h)
250 (10)
225 (9)
200 (8)
175 (7)
150 (6)
125 (5)
100 (4)
75 (3)
50 (2)
25 (1)
0
100 - year storm
25 - year storm
10 - year storm
5 - year storm
0 10 20 30 40 50 60 70 80 90 100 110 120
Duration (minutes)


Depth ratio
1.0
0.8
0.6
0.4
0.2
0
Discharge ratio
Velocity ratio
0 0.2 0.4 0.6 0.8 1.0 1.2
Hydraulic Element ratio