UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	HYDROLOGY
COURSE CODE	:	BFC 32002
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**. 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

Q1 (a) With the aid of diagrams/equation, briefly explain for each of the following **TWO (2)**:

(i) types of aquifers.

(3 marks)

(ii) parameters of groundwater storage.

(3 marks)

(b) An open channel runs almost parallel to a river as shown in **Figure Q1(b)**. The current water level in the river is at an elevation of 122 ft and in the channel is at an elevation of 104 ft. The river and channel are 2232 ft apart and a previous formation of average 35 ft thickness with moist movement at hydraulic conductivity of 0.28 ft/hr. Determine the rate of seepage flow from the river to the channel.

(3 marks)

(c) An aquifer of 25 m average thickness is overlain by an impermeable layer of 35 m thickness. A test well of 0.5 m diameter and two observation wells at a distance of 10 m and 60 m from the test well are drilled through the aquifer. After pumping at a rate of 0.15 m^3/s for a long time, the following drawdowns are stabilized in these wells: first observation well, 4.5 m; second observation well, 3.5 m. Determine the hydraulic conductivity.

(i) Illustrate the cross section of the confined aquifer system and label the values.

(3 marks)

(ii) Following **Table Q1(c)**, examine the type of soil media surrounding this well based on your hydraulic conductivity result.

(2 marks)

(iii) Analyse the drawdown in the test well for both observations.

(6 marks)

(d) As a groundwater engineer, plan and write on how you would do to know the capability of an aquifer of a recommended location, to provide adequate water that meets the demand of quantity of water.

(5 marks)

Q2 (a) In your opinion, explain the importance of flood routing in terms of design and modelling for hydrology.

(3 marks)

(b) The surface storage facility controls runoff from a residential area where weir controls the outflow from the basin. The reservoir routing curves are shown in **Figure Q2(b)**.

(i) Analyse the outflow hydrograph from the inflow (refer **Table Q2(b))** using the Puls method.

(17 marks)

(ii) Plot the inflow and outflow hydrographs.

(5 marks)

Q3 (a) Define unit hydrograph (UH) and state **TWO (2)** applications of UH in engineering hydrology.

(3 marks)

(b) Daily streamflow for Sembrong catchment with an area of 5650 km^2 is shown in **Table Q3(b)**.

(i) Plot the hydrograph.

(2 marks)

(ii) By using any **TWO (2)** separation methods, compare the baseflow for this catchment.

(6 marks)

(iii) Compute the UH ordinates.

(6 marks)

(iv) Plot the UH

(2 marks)

(c) Examine the peak flow, time to peak and base time of the 3-hr Snyder UH for a 50 km^2 catchment where the main river is 12 km long and the distance from the catchment outlet to the point on the stream nearest to the centroid of the catchment is 4 km. Assume that $C_p = 0.6$ and $C_t = 1.7$.

(6 marks)

Q4 (a) With the aid of hydrograph, explain on how urbanization affects the hydrological cycle in a forest.

(5 marks)

(b) Based on typical method used, discuss on why peak flow estimation of a catchment is important in any pre-development.

(5 marks)

(c) Based on the map in Tasik Kenyir, Hulu Terengganu area shown in **Figure Q4(c)**:

(i) Select **ONE (1)** of any potential sub-catchments and draw the catchment boundary on the given map.

(2 marks)

(ii) Measure the selected sub-catchment area using any basic method (show your calculation in the given map).

(3 marks)

(iii) Identify the peak flow for this catchment area using the Rational Method. Refer **Table Q4(c)(i)** – **Table Q4(c)(ii)** and **Figure Q4(c)**.

(10 marks)

-END OF QUESTIONS-

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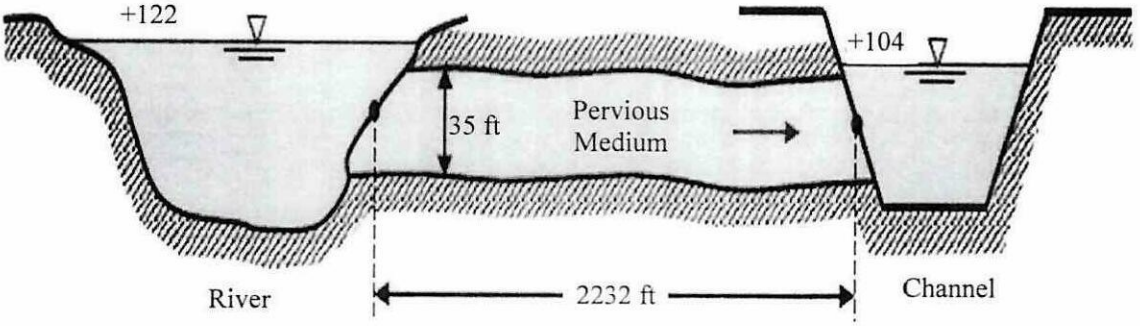

Figure Q1(b) : A parallel river and channel

Table Q1(c): Hydraulic conductivity

Material	Hydraulic conductivity (m/day)
Gravel, coarse	150
Gravel, medium	270
Gravel, fine	450
Sand, coarse	45
Sand, medium	12
Sand, fine	2.5
Silt	0.08
Clay	0.0002
Sandstone, fine-grained	0.2
Sandstone, medium-grained	3.1
Limestone	0.94

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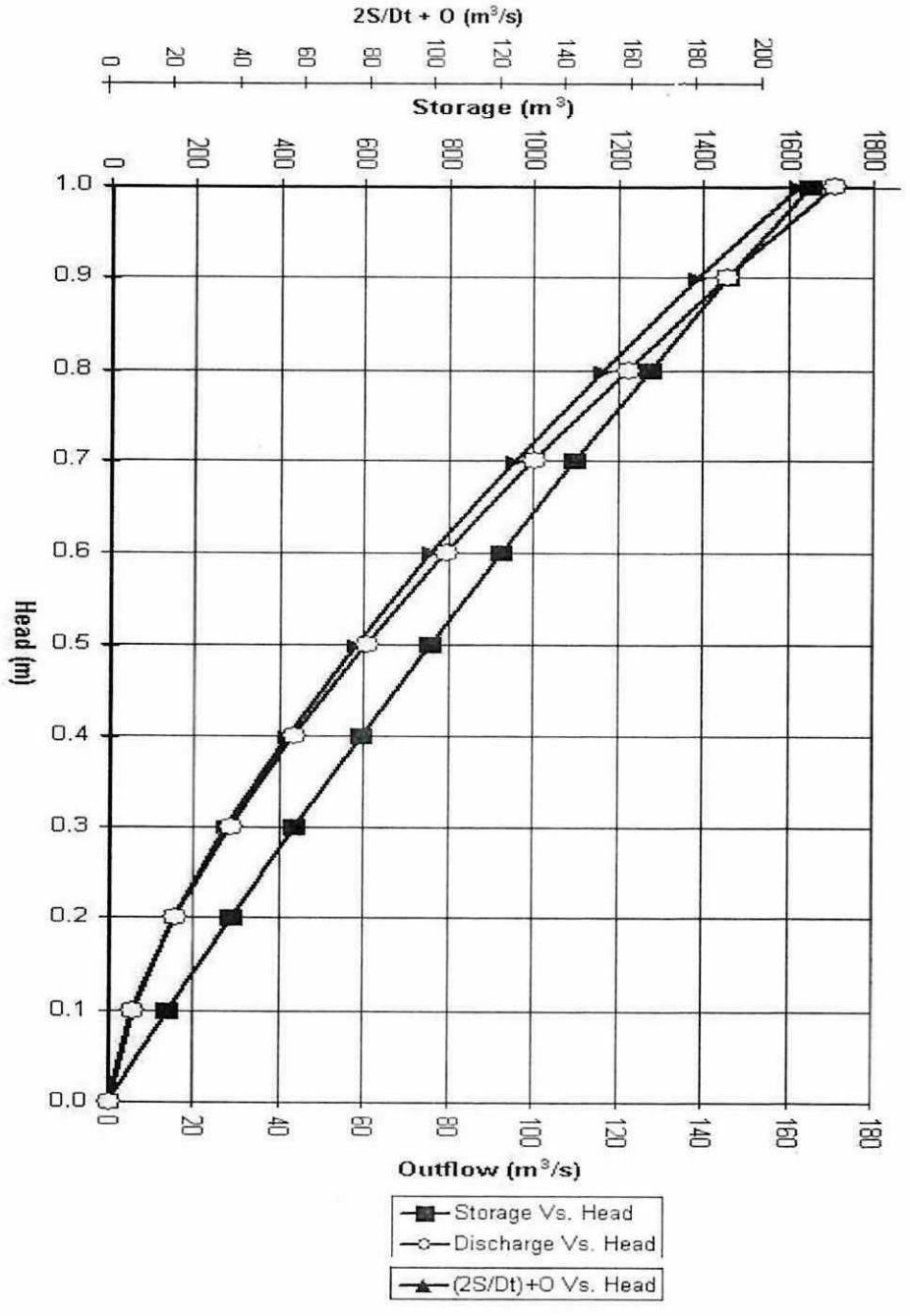

Figure Q2(b) : Reservoir rating curves

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Table Q2(b)

Time (min)	0	15	30	45	60	75	90	105
Inflow (m^3/s)	0	10	35	49	38	21	11	5

Table Q3(b)

Time (day)	1	2	3	4	5	6	7	8
Total flow, Q (m^3/s)	1500	1350	4730	6900	8800	4210	2000	1200

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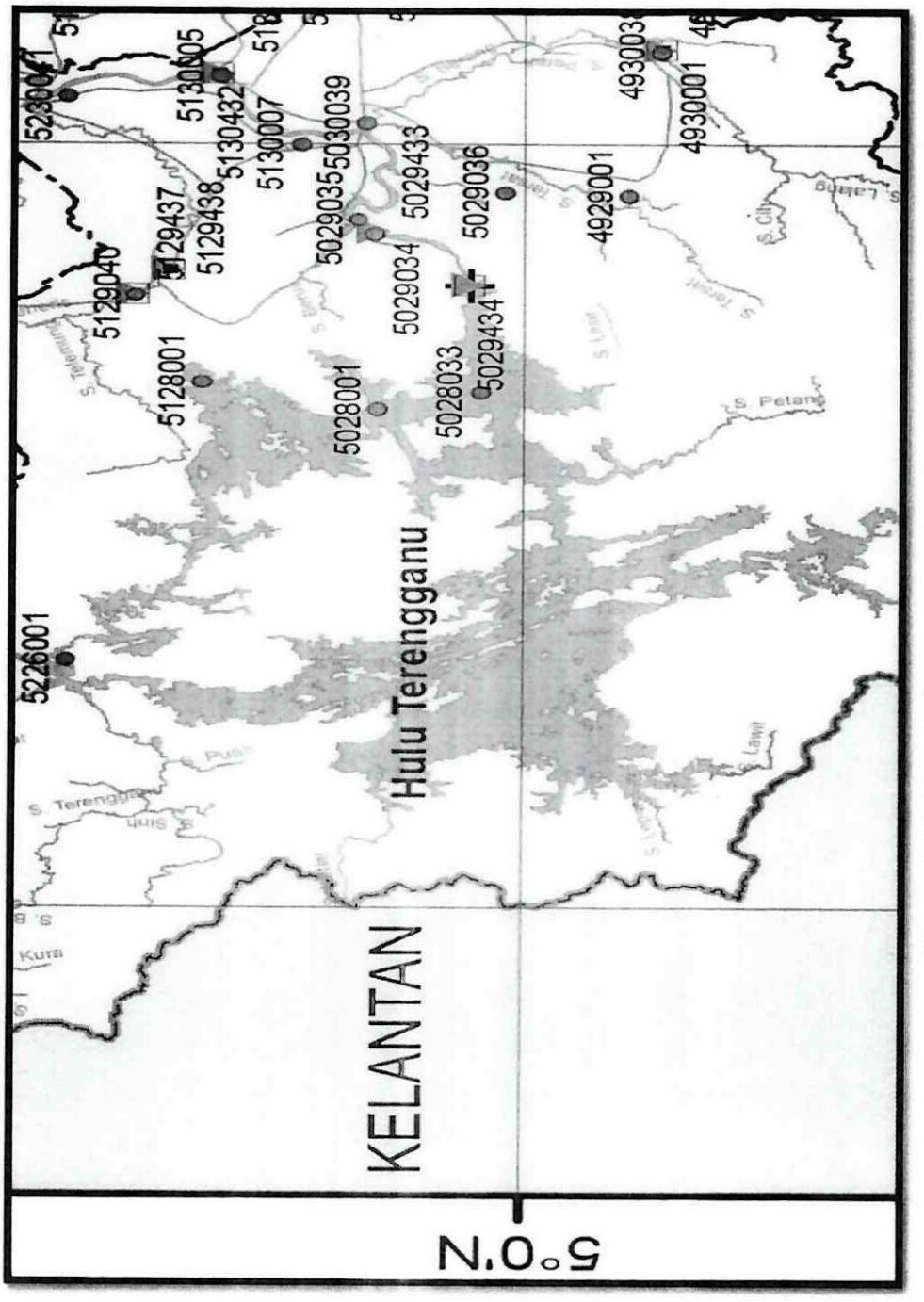

Figure Q4(c): Hydrological Stations in Hulu Terengganu

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TEAR OUT THIS PAGE AND ATTACH TOGETHER IN YOUR ANSWER SHEET

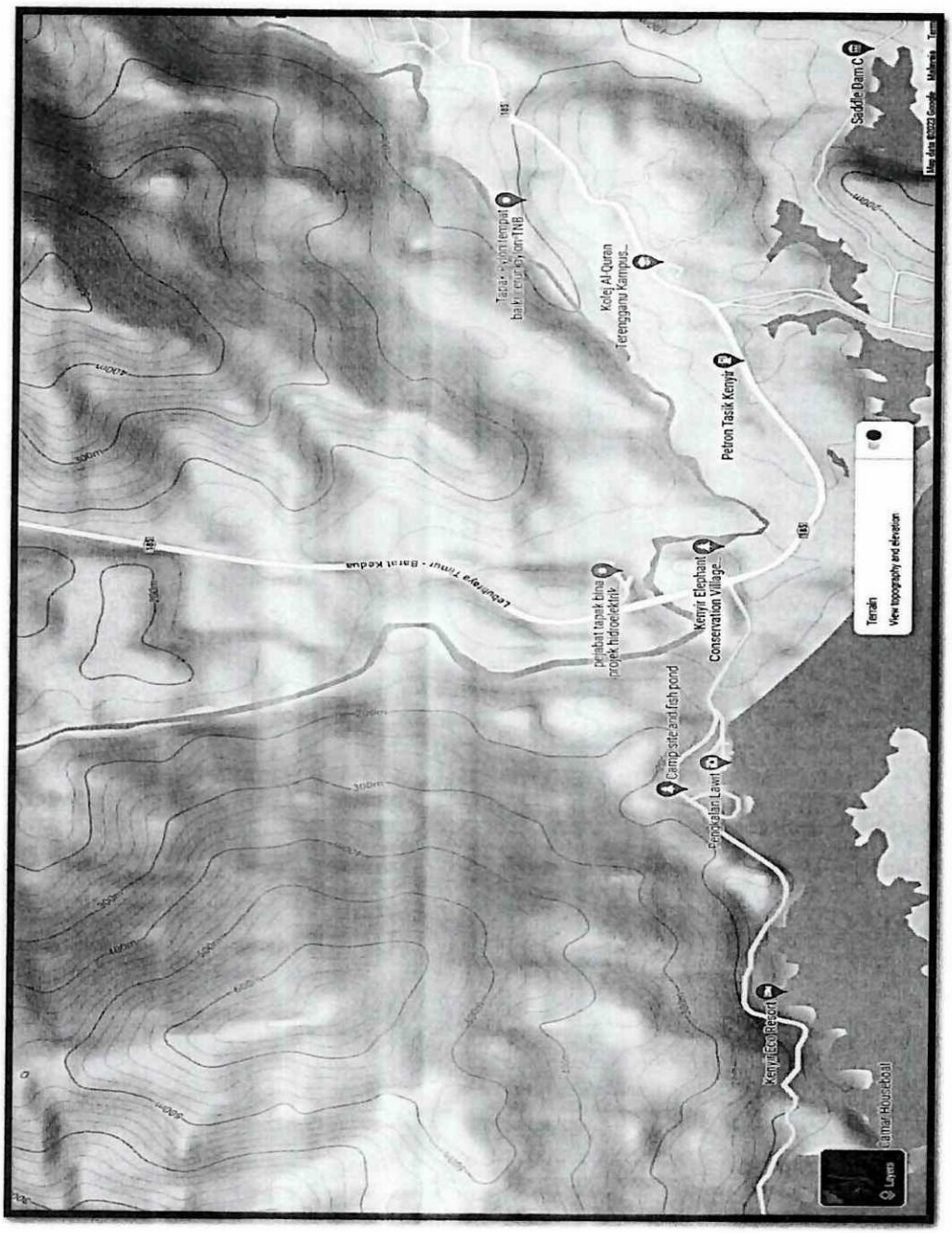

Figure Q4(c): Part of terrain map of Tasik Kenyir Hulu Terengganu (Scale 1 cm : 3.28 km)

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Table Q4(c)(i): Recommended Runoff Coefficient for Various Land uses

Land use	Runoff Coefficient (C)	
	For Minor System (≤ 10 years ARI)	For Major System (≥ 10 years ARI)
Residential Area	0.70	0.75
Commercial and Business Centres	0.90	0.95
Sport Fields, Parks and Agriculture	0.30	0.40
Open Spaces – Grass Cover	0.40	0.40
Forest	0.60	0.10
Roads and Highways	0.95	0.95

Table Q4(c)(ii): Fitting constants for the IDF empirical equation for the different location in Malaysia for high ARIs between 2 and 100 year and storm duration from 5 minutes to 72 hours

State	No	Station ID	Station Name	Constant			
				λ	κ	θ	η
Terengganu	1	4930038	Kg Menerong, Hulu Trg	60.436	0.204	0.063	0.588
	2	5029034	Kg Dura. Hulu Trg	60.510	0.220	0.087	0.617
	3	5128001	Sungai Gawi, Hulu Trg	48.101	0.215	0.027	0.566
	4	5226001	Sg Petualang, Hulu Trg	48.527	0.228	0.000	0.547

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$$H - h = \frac{Q}{2\pi bK} ln \frac{R}{r} \qquad s_w - s_2 = \frac{Q}{2\pi bK} ln \frac{R}{r_w} \qquad Q = \frac{KA(h_1 - h_2)}{L}$$

$$t_P = \frac{t_R}{2} + t_{lR} \qquad t_{lR} = t_l + 0.25(t_R - t_r) \qquad t_r = \frac{t_l}{5.5} \qquad t_l = 0.75 C_t (LL_c)^{0.3}$$

$$T_B = 72 + 3t_{lR} \qquad Q_p = 2.78 \frac{C_p A}{t_l} \qquad 2S_1/\Delta t - O_1 \qquad 2S_2/\Delta t + O_2 \qquad Q = \frac{CiA}{360}$$

$$C_{avg} = \frac{\sum_{j=1}^{m} C_j A_j}{\sum_{j=1}^{m} A_j} \qquad i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}}$$