Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	HYDROLOGY
COURSE CODE	:	BFC 32002
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2024
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ 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 **NINE (9)** PAGES

Q1 (a) Define the following.

(i) Rainfall depth

(1 mark)

(ii) Frequency of rain

(1 mark)

(iii) Evapotranspiration

(1 mark)

(b) As a hydrologist, you are required to measure the mean areal rainfall of Sri Gading basin (**Figure Q1.1**). Using isohyetal method,

(i) Plot the potential interpolation lines between gauge stations shown in **Figure Q1.1**.

(2 marks)

(ii) Using grid method, predict the sub-area between each isohyet lines proposed in **Q1(b)(i)** (Show all your answers on the given basin map in **Figure Q1.1 (Appendix A).**

(5 marks)

(iii) Estimate the average rainfall for Sri Gading basin (**Figure Q1.1**).

(4 marks)

(c) Intensity of rainfall that occurred within the 52-ha catchment area is provided in **Table Q1.1**. Given a surface runoff volume of 23000 m^3, predict the Ø index for the catchment area. Show your answers and assumptions in the form of hyetograph sketch.

Table Q1.1

Time (hour)	Rainfall depth (mm)
0.5	10
1.0	24
1.5	54
2.0	34
2.5	8
3.0	0

(11 marks)

Q2 (a) With the aid of diagram, define:

(i) catchment boundary

(2 marks)

(ii) time of concentration t_c of a catchment area

(2 marks)

(iii) intensity-duration-frequency curve

(2 marks)

(b) (i) Name **ONE (1)** typical method used for peak flow estimation in a catchment.

(1 mark)

(ii) Based on your answer in **Q2(b)(i)**, explain on how to use this method with the aid of graph and equation.

(4 marks)

(iii) Explain **TWO (2)** importance of estimating peak flow before development.

(3 marks)

(c) Stream-gauging works have been carried out in Batu Pahat river. A cross-section survey is shown in **Figure Q2.1**. Using mean section method,

(i) propose your vertical sections, section widths and shapes based on **Figure Q2.1**. Please display all your answers on the given river cross section in **Figure Q2.1(Appendix C).**

(6 marks)

(ii) compute the discharge of the Batu Pahat river.

(5 marks)

Q3 (a) Explain **ONE (1)** main difference between hydrograph and unit hydrograph.

(3 marks)

(b) With the aid of graph, explain **THREE (3)** main parameters of a hydrograph that are important in hydrological design.

(6 marks)

(c) Explain **TWO (2)** important uses of unit hydrograph.

(4 marks)

(d) A storm hydrograph with its corresponding excess rainfall is shown in **Table Q3.1**. Using convolution method,

Table Q3.1 Storm hydrograph with rainfall excess

Time (hr)	Rainfall excess (mm)	Direct discharge (m^3/s)
0.5	15	28
1.0	35	680
1.5	20	900
2.0	10	1800
2.5		1150
3.0		320
3.5		100
4.0		30

(i) find total number of direct runoff (DRO) ordinates

(2 marks)

(ii) compute the unit hydrograph ordinates

(8 marks)

(iii) plot the UH

(2 marks)

Q4 (a) Describe **TWO (2)** applications of streamflow and reservoir routing in hydrology engineering.

(5 marks)

(b) Briefly describe **ONE (1)** difference between Muskingum and Puls routing methods.

(3 marks)

(c) Reservoir routing curves of a dam are shown in **Figure Q4.1**. Without any flood event, all the spillway crest height, and storage capacity increments are at zero reading level (Refer **Appendix C**).

Table Q4.1 The inflow hydrograph data of the reservoir due to flood event

Time (day)	0	0.5	1	1.5	2	2.5
Inflow (m^3/s)	0	50	100	175	40	32

(i) Using the Puls method, compute the outflow hydrograph of a flood event using the inflow data given in **Table Q4.1**.

(14 marks)

(ii) Plot the inflow and outflow hydrographs.

(3 marks)

-END OF QUESTIONS-

APPENDIX A

TEAR THIS PAGE OUT AND ATTACH TOGETHER WITH YOUR ANSWER SHEET.

DRAW YOUR PROPOSE METHOD ON THIS PAGE.

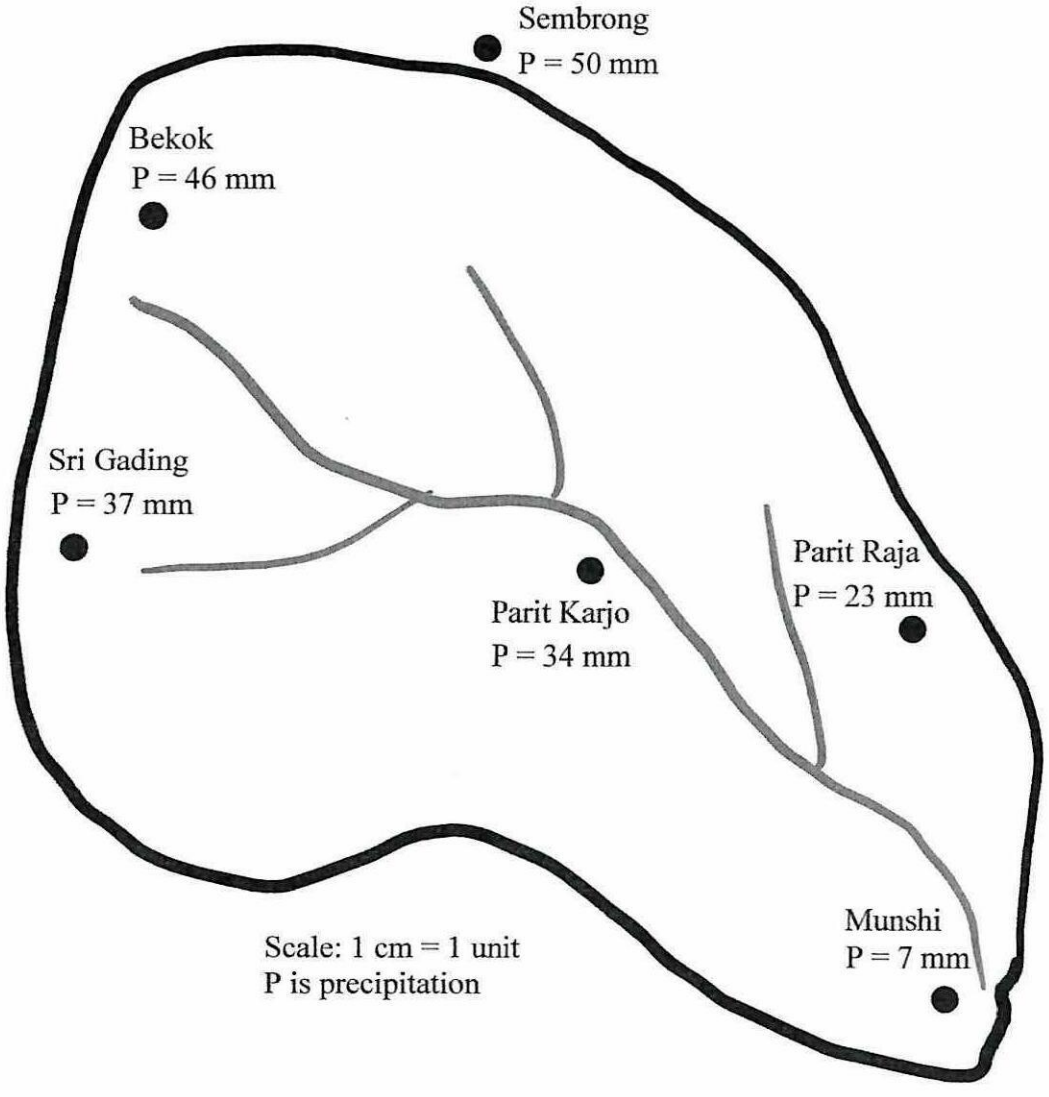

Figure Q1.1 Location of rainfall stations in Sri Gading basin

APPENDIX B

TEAR THIS PAGE OUT AND ATTACH TOGETHER WITH YOUR ANSWER SHEET

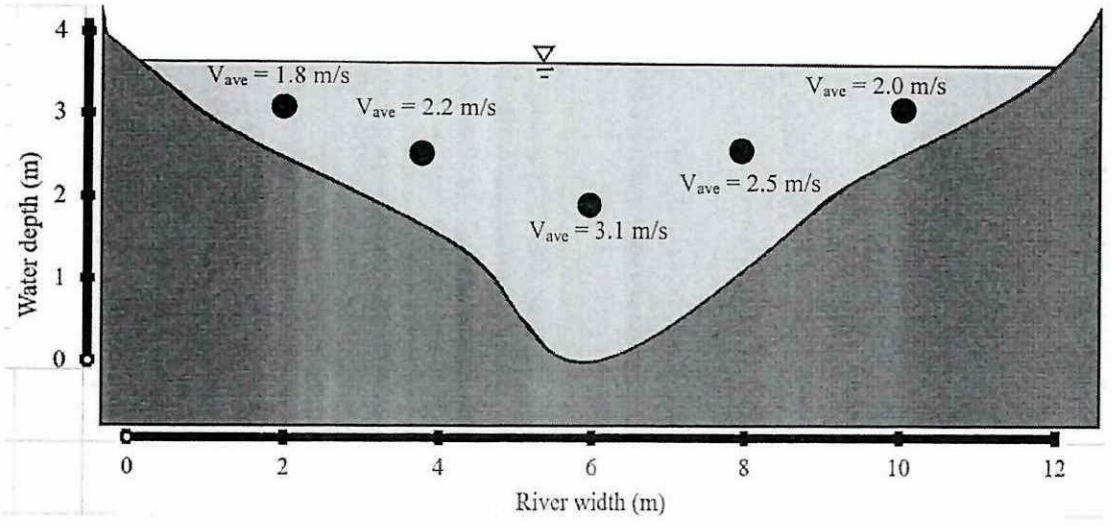

Figure Q2.1: A cross section of Batu Pahat River

APPENDIX C

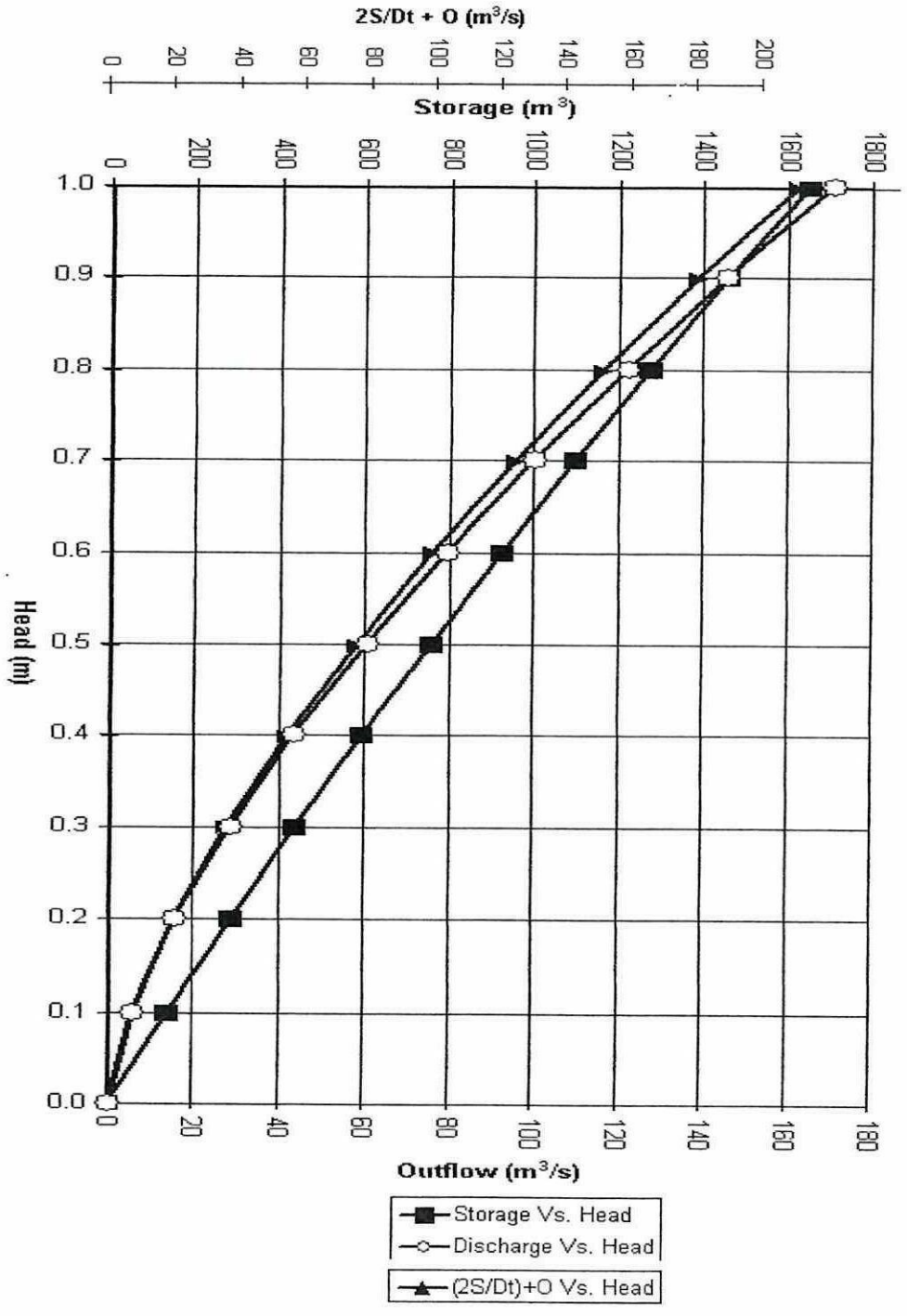

Figure Q4.1 : Reservoir rating curves

APPENDIX D : EQUATIONS SHEET

$$L_i^2 = x^2 + y^2 \qquad W_i = \frac{(1/L_i^2)}{\sum_{i=1}^{n}(1/L_i^2)}$$

$$P_x = \sum_{i=1}^{n} W_i P_i \qquad \emptyset = \frac{P-R}{t_e} \qquad Q = AV$$

$$Q_n = P_m U_1 + P_{m-1} U_2 + P_{m-2} U_3 + \ldots P_1 U_{(n-m+1)}$$

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