Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	WATER RESOURCES ENGINEERING
COURSE CODE	:	BFW 40103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
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 **EIGHT (8)** PAGES

Q1 (a) Discuss on the Malaysian Water Vision that has been formulated by the Government.

(5 marks)

(b) You have been tasked to evaluate the downstream effects of recent flooding in Johor river. With aid of sketch, propose a routing system that could lessen the impact of flood within that downstream area.

(6 marks)

(c) Using one appropriate technique, develop a unit hydrograph for a basin with area of 412.2 km^2, utilise the streamflow data tabulated in **Table Q1.1**.

Table Q1.1 Streamflow data

Time (h)	Flow, Q (m^3/s)
0	160
1.5	150
3	350
4.5	800
6	1200
7.5	900
9	750
10.5	450
12	150

(14 marks)

Q2 (a) Discuss on the relationship of reservoir storage-firm yield analysis and its use in water supply management.

(5 marks)

(b) With the aid of a sketch of appropriate simulation drought index, explain the **THREE (3)** variables that are used to characterise droughts.

(6 marks)

(c) Annual maximum series of peak flow recorded in Klang river with a standard deviation of $\sigma_x = 6189$ m³/s is shown in **Table Q2.1**.

Table Q2.1 Annual maximum flow

Year	Flow (m^3)	Year	Flow (m^3)
1960	942	1966	283
1961	1060	1967	322
1962	1000	1968	404
1963	1500	1969	787
1964	1080	1970	22100
1965	6460	1971	4410

(i) Compute the 100-year return period of peak flow using the Gumbel and Normal distributions. The K_T values for Normal distribution are given in **Table Q2.2**.

Table Q2.2 Normal distribution K_T value

T (Year)	Probability of exceedance	K_T
100	0.01	2.33
50	0.02	2.05
20	0.05	1.64
10	0.1	1.28
5	0.2	0.84
2	0.5	0.00

(12 marks)

(ii) Discuss the difference of the peak flow values in both distributions.

(2 marks)

Q3 (a) A project proposal has to be prepared for new dam construction. Your task is to propose **TWO (2)** appropriate hydraulic structures which will be used to release water and/or reduce energy from the reservoir of the dam.

(5 marks)

(b) You are hired to consult on ecohydrology concept that is to be applied at a new residential area in Bukit Kiara, Kuala Lumpur. In your proposal, include the stormwater ecohydrology components and their functions.

(6 marks)

(c) A reservoir covers an area of 850 km^2 and has an average depth of 18.7 m. The inflow to the reservoir is from a river with an average flowrate of 2500 m^3/s and suspended sediment concentration of 250 mg/L. Estimate rate of sediment accumulation and the time it will take for the reservoir storage to decrease by 10%. Assume that the accumulated sediment has a bulk density of 1600 kg/m^3 **Figure APPENDIX A.1**.

(14 marks)

Q4 (a) With the aid of a sketch, explain on the sequence of processes used in a typical raw water treatment works.

(5 marks)

(b) Gravity, pumping and combined systems are three water distribution methods. Give your opinion on the suitability of the methods for water distribution of new development.

(6 marks)

(c) Pipe culvert of size 1.05 m at a new housing area need to be increased to reduce the velocity. The given flow rate and tailwater are 1.7 m^3/s and 0.61 m, respectively. Compute the reduction in velocity by replacing it with a larger pipe culvert. You can use **Table APPENDIX B.1** as reference and **Figure APPENDIX C.1 – APPENDIX C.3.**

(14 marks)

- END OF QUESTIONS -

APPENDIX A

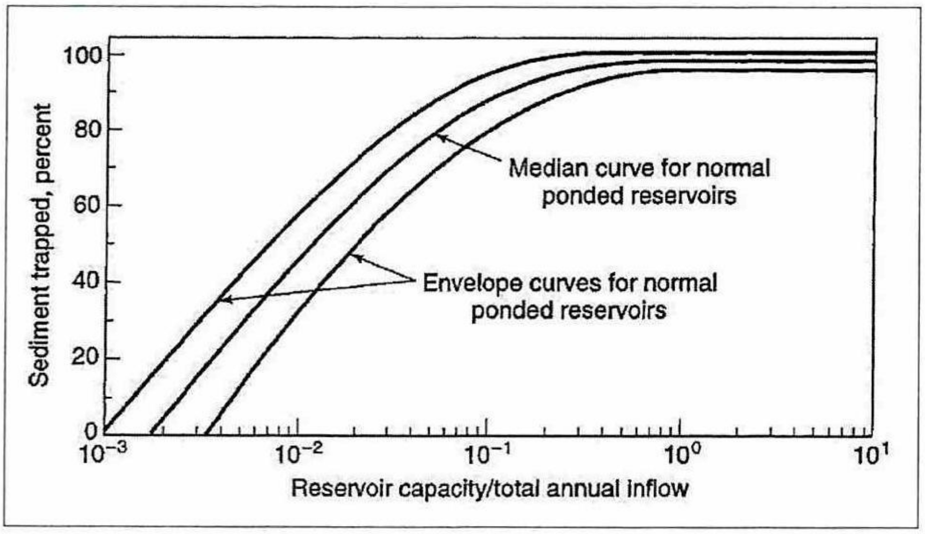

Figure APPENDIX A.1 Sediment trap efficiency in a reservoir

APPENDIX B

Table APPENDIX B.1 Culvert Design

D (m)	$1.811\ Q/D^{5/2}$	TW/D	y_o/D	y_o (m)	y_c (m)	A/D^2	A (m^2)	$V = Q/A\ (\frac{m}{s})$
1.05								
1.2								
1.35								
1.5								

APPENDIX C

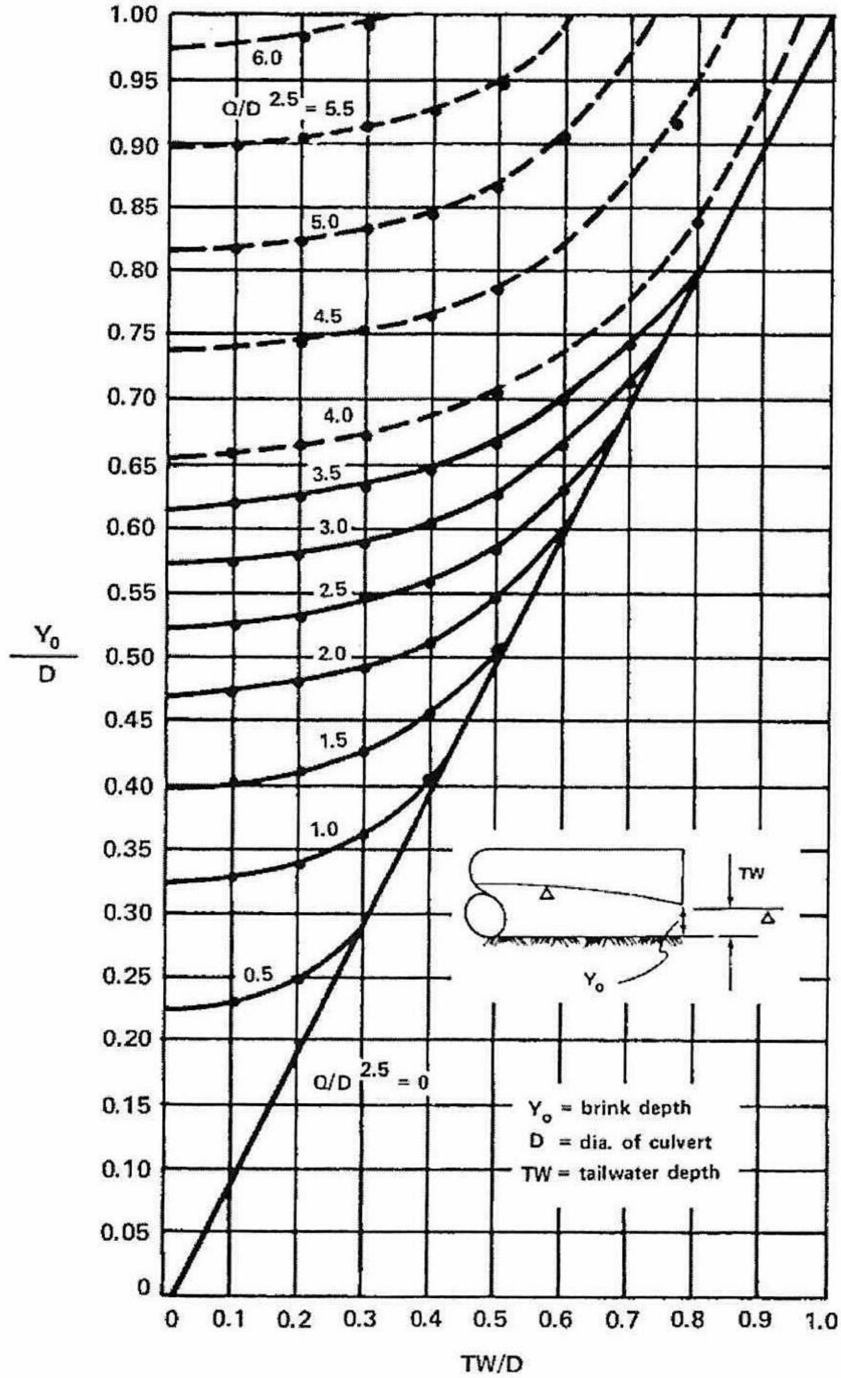

Figure APPENDIX C.1 Dimensionless Rating Curves for the Outlets of Circular Culverts on Horizontal and Mild Slopes

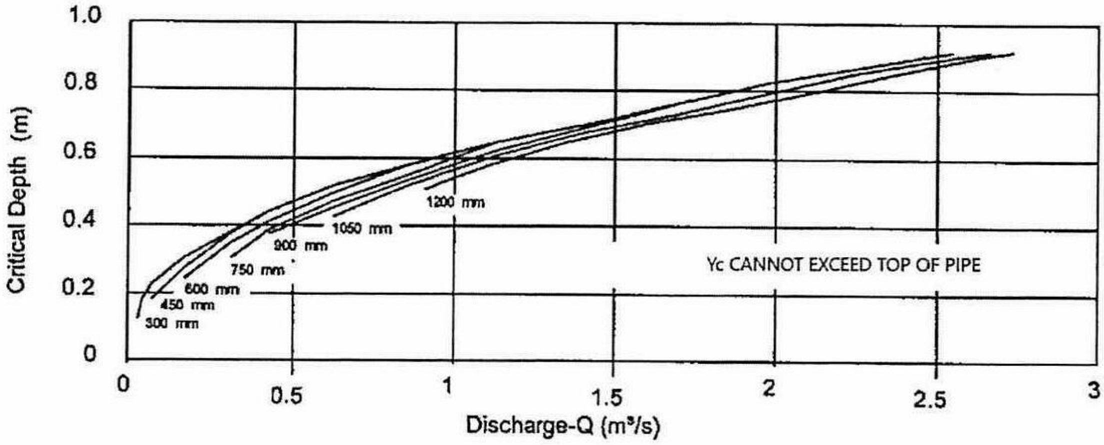

Figure APPENDIX C.2 Critical Depth of Circular Pipe

y/D	A/D^2	R/D	$\frac{(\alpha Qn)}{(D^{8/3} S^{1/2})}$	$\frac{(\alpha Qn)}{(y^{8/3} S^{1/2})}$
0.37	0.2642	0.2020	0.1351	1.915
0.38	0.2739	0.2062	0.1420	1.875
0.39	0.2836	0.2102	0.1490	1.835
0.40	0.2934	0.2142	0.1561	1.797
0.41	0.3032	0.2182	0.1633	1.760
0.42	0.3130	0.2220	0.1705	1.724
0.43	0.3229	0.2258	0.1779	1.689
0.44	0.3328	0.2295	0.1854	1.655
0.45	0.3428	0.2331	0.1929	1.622
0.46	0.3527	0.2366	0.201	1.590
0.47	0.3627	0.2401	0.208	1.559
0.48	0.3727	0.2435	0.216	1.530
0.49	0.3827	0.2468	0.224	1.500
0.50	0.3927	0.2500	0.232	1.471

y/D	A/D^2	R/D	$\frac{(\alpha Qn)}{(D^{8/3} S^{1/2})}$	$\frac{(\alpha Qn)}{(y^{8/3} S^{1/2})}$
0.51	0.4027	0.2531	0.239	1.442
0.52	0.4127	0.2562	0.247	0.415
0.53	0.4227	0.2592	0.255	1.388
0.54	0.4327	0.2621	0.263	1.362
0.55	0.4426	0.2649	0.271	1.336
0.56	0.4526	0.2676	0.279	1.311
0.57	0.1626	0.2703	0.287	1.286
0.58	0.4724	0.2728	0.295	1.262
0.59	0.4822	0.2753	0.303	1.238
0.60	0.4920	0.2776	0.311	1.215
0.61	0.5018	0.2799	0.319	1.192
0.62	0.5115	0.2821	0.327	1.170
0.63	0.5212	0.2842	0.335	1.148
0.64	0.5308	0.2862	0.343	1.126

Figure APPENDIX C.3 Uniform Flow in Circular Sections Flowing Partly Full

EQUATIONS

$\mu_x = b + 0.577a$ $\sigma_x^2 = 1.645a^2$ $g_x = 1.1396$ $a = \frac{\sigma_x}{\sqrt{1.645}}$ $b = \mu_x - 0.577a$

$$Y = \frac{X - b}{a}$$

$$F(y) = \exp[-\exp(-y)]$$

$$x_T = \mu_x + K_T\sigma_x$$

$$\text{Ratio of storage} = \frac{\text{storage capacity}}{\text{innual inflow}}$$