Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	WATER SYSTEM DESIGN AND MANAGEMENT
COURSE CODE	:	BFC 35303
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY/FEBRUARY 2024
DURATION	:	3 HOURS
INSTRUCTION		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) With the aid of sketches, explain **TWO (2)** differences between separate sewerage system, and combine sewerage system.

(6 marks)

(b) A sewerage reticulation plan for Taman Parit Raja as shown in **Figure Q1.1**.

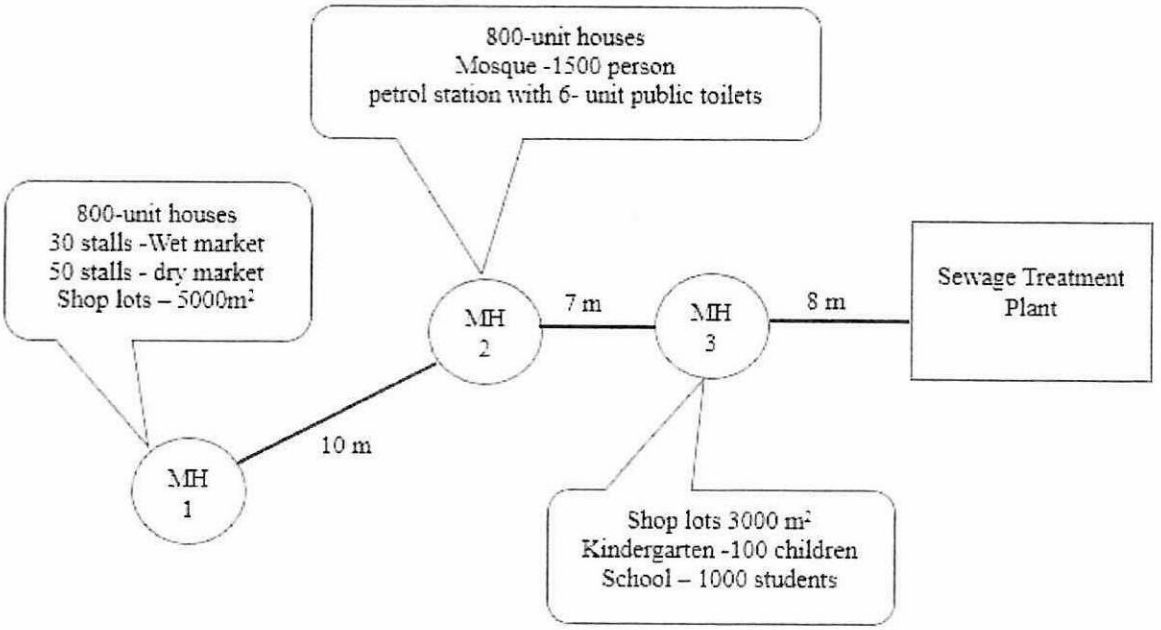

Figure Q1.1 This figure shows the sewerage reticulation plan.

(i) Based on **Figure Q1.1** and **Table Q1.1,** calculate total population equivalent (PE) for the proposed sewerage reticulation plan.

Table Q1.1 This table shows the population equivalent.

Type of establishment	Population equivalent
Residential	5 per house
Commercial: Includes offices, shopping complex, entertainment/ recreational centres, restaurants, cafeteria and theatres	3 per 100 m^2 gross area
School/ Educational institutions: - Day schools/ institutions - Fully residential - Partial residential	 0.2 per student 1 per student 0.2 per non-residential student
Market (wet type)	3 per stall
Market (dry type)	1 per stall
Petrol kiosks/ service stations	15 per toilet
Mosque/ church/ temple	0.2 per person

(8 marks)

(ii) Based on **Figure Q1.1**, recommend a sewerage reticulation system for MH1 to MH2 using new vitrified clay sewer (n =0.010) running at full flow condition. Assume ground level and upper invert level are 25.200 m and 24.055 m, respectively.

(11 marks)

Q2 (a) Based on your understanding, explain the stormwater management mechanism and implementation in minimizing the effects of land use changes.

(6 marks)

(b) **Figure Q2.1** shows drainage catchment of Wangsa Maju. Calculate time of concentration, t_c at Subcatchment 1. The slope of overland surface is 3.74% and the friction slope of the channel is 0.02. From the site visit, the depth and the width of the triangular channel are 0.3 m and 0.6 m, respectively. Assume Horton's Roughness, n and manning coefficient, n are both equal to 0.015. The proposed channel geometry for the drainage system **Figure Q2.2**.

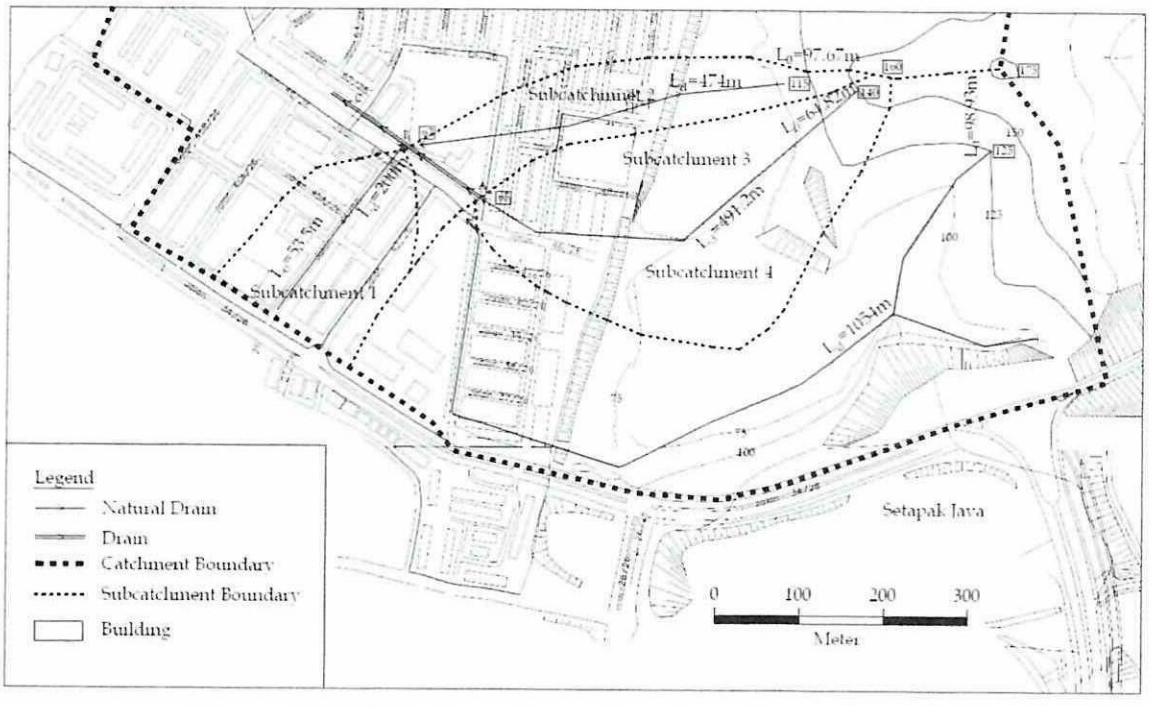

Figure Q2.1 This figure shows the sub catchment drainage.

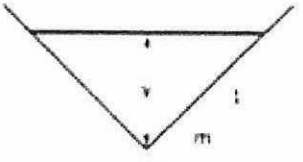

Figure Q2.2 This figure shows the dimensions of channel geometry.

(8 marks)

(c) A lined drain is proposed for a new residential project in Lendu, Melaka to convey design flow for 19 year ARI minor system. Assume B = 0.7 m, recommend the size of lined drain that could cater the discharge after the development. Use the following:

1) Post-development time of concentration, t_c = 45 minutes
2) Runoff coefficient,C = 0.8
3) Manning coefficient, n = 0.015
4) Side slope, Z = 0
5) Minimum freeboard = 50 mm
6) λ = 72.163
7) κ = 0.184
8) θ = 0.376
9) η = 0.900

(11 marks)

Q3 (a) Erosion and Sediment Control Plan (ESCP) consisted of EIGHT (8) components as illustrated in **Figure Q3.1** Explain briefly any **THREE (3).**

Figure Q3.1 This figure shows the ESCP components.

(6 marks)

(b) (i) The sediment basin of a construction area was built at 90% efficiency to manage the sediment yield of 80 tonne. Consider the density of sediment and sediment storage zone of 1600kg/m^3 and 900 m^3 respectively. Estimate the sediment trapping efficiency.

(4 marks)

(ii) Provide an illustration of a control facility for erosion and sediment control within a construction area which is having earthwork activity. In the illustration, propose the best management practice (BMP) for erosion and sediment and place the control facilities.

(4 marks)

(c) (i) Recommend settling zone of dry sediment basin for a construction area of 5 ha by considering design criteria of **Table Q3.1** and **Table Q3.2.** Assume time of concentration of basin catchment is 30 minutes.

Table Q3.1 This table shows Sediment basin design criteria.

Parameter	Requirement
Storage volume	Settling zone volume = half of total storage Sediment zone volume = half of total storage
Basin dimension	Minimum length to width ratio= 2:1 Minimum length to settling depth ratio= 200:1 Minimum settling zone depth =0.6 m Minimum sediment storage zone depth =03 m
Embankment	Side slope 2 (H): 1 (V) or flatter

Table Q3.2 This table shows the time of concentration of basin catchment.

Parameter	Time of Concentration of Basin Catchment (minutes)				
	10	20	30	45	60
Surface area (m^2/ha)	333	250	200	158	121
Total volume (m^2/ha)	400	300	240	190	145

(9 marks)

(ii) Based on the design in Q3(c)(i), comment on whether the sediment basin dimension remain the same if the time of concentration is changed to 45 minutes

(2 marks)

Q4 (a) Grid system (or looped system) is one of the water distribution systems. Explain **THREE (3)** benefits of this system.

(6 marks)

(b) A new development project consisting of residential and commercial premises is proposed. Using **Table Q4.1,** calculate the water demand for the project with establishment as in **Table Q4.2,** and estimate the peak flow.

Table Q4.1 This table shows average daily water demand.

Type of Premises/Buildings	Average Daily Water Demand (Litres)
Single storey terrace house/low cost house (less than RM 25,000)/ low medium & medium cost flats	1300/unit
Double storey terrace house/high cost flat/apartment/town house	1500/unit
Semi detached house/cluster	2000/unit
Wet market	1500/stall
Dry market	450/stall
Shop house (single storey) /low-cost shop	2000 /unit
Shop house (double storey)	3000/unit
Shop house (three storey)	4100/unit
Office/complex/commercial (domestic usage)	1000/100 square meter
Community centres or halls	1000/100 square meter
Petrol kiosk (with car washing bay)	50000/unit
Petrol kiosk (without car washing bay)	10000/unit

Table Q4.2 This table shows the quantity for different premises.

Type of Premises/Buildings	Unit
Single storey terrace house	1000
Double storey terrace house	500
Semi detached house	200
Wet market	40
Dry market	100
Shop house (single storey)	100
Shop house (double storey)	100
Office/complex/commercial (domestic usage)	2000 m^2
Community centres or halls	500 m^2
Petrol kiosk (without car washing bay)	1

(8 marks)

(c) (i) Recommend the available pressure at location of pressure test and available pressure at location of proposed connection point for a purposed development project using the following:

1)	Residual Pressure	: 28.0 m
2)	Ground level	: 25.20 m
3)	Depth of pipe	: 1.0 m
4)	Pipe length	: 3 km
5)	Head loss in pipe due to friction	: 2m/1000m

(4 marks)

(ii) For the closed loop as shown in **Figure Q4.1** with K =500, find discharge in all pipes. Limit to **TWO (2)** iterations.

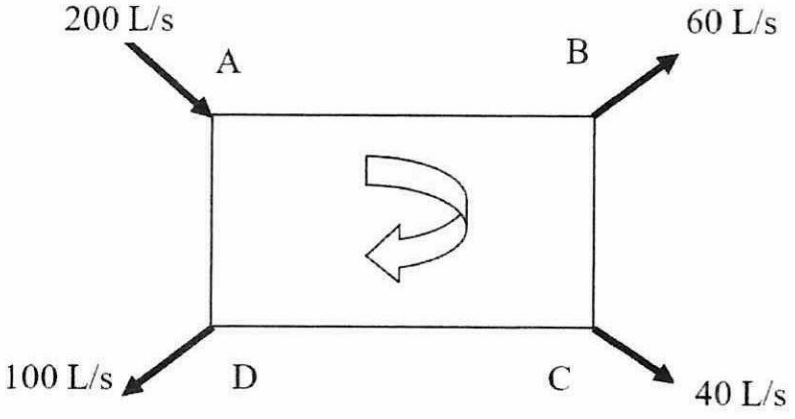

Figure Q4.1 This figure shows the closed loop for the water distribution.

(7 marks)

-END OF QUESTIONS-

APPENDIX

EQUATIONS

$$Peak\ factor = 4.7\left(\frac{PE}{1000}\right)^{-0.11} \qquad i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}} \qquad Q = \frac{CiA}{360}$$

$$t_o = \frac{107\,n\,L^{1/3}}{S^{1/2}} \qquad t_d = \frac{nL}{60\,R^{2/3}S^{1/2}\pi}$$

$$A = (B + ZD)D \qquad P = B + 2D\sqrt{1+Z^2}$$

$$A = my^2 \qquad P = 2y(1+m^2)^{1/2}$$