Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	WATER SYSTEM DESIGN AND MANAGEMENT
COURSE CODE	:	BFC 35303
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
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 **NINE (9)** PAGES

Q1 (a) Consider a gravity pipeline transmits water from service reservoir to distribution network. The flow rate is 4000 m^3/day and length is 5 km. Difference in elevation between service reservoirs to its distribution network is 12 m. Considering effect of minor losses, the planar length is increased by 2%. Determine the diameter of the steel pipe required.

(10 marks)

(b) A new residential area is to be developed in Batu Pahat, Johor. You are assigned to recommend a water reticulation system for the project. Total development area is 2500 acres.

(i) Use **Table Q1(b)(i)** for the selection of development's type and **Table Q1(b)(ii)** to calculate the total water demand (in m^3/s) for domestic use.

(7 marks)

(ii) Recommend the size of required suction tank and elevated tank.

(8 marks)

Q2 (a) Differentiate the required buffer zone of sewage treatment plant for buried/covered plant and enclosed plant situated on residential area.

(7 marks)

(b) A sewerage system plan as shown in **Figure Q2(b)** is proposed. Using Malaysia Sewerage Industry Guideline (MSIG), recommend a sewerage reticulation system using new vitrified clay sewer (n =0.010) and **Table Q2(b)** in which the sewerage can easily flow by gravity. Assume ground level and invert ground level are 24.200 m and 23.088 m respectively.

(18 marks)

Q3 A 10 hectare agriculture land is proposed to be developed as residential area. The proposed area has the following characteristics:

i.	Rainfall station	:	Kg Sawah Lebar (λ =54.4194, κ =0.1916, θ =0.2630, and η =0.8501)
ii.	Total catchment area	:	50.0 ha (or 500,000 m^2)
iii.	Sub-catchment area	:	10.0 ha
iv.	Impervious area (covered up)	:	3.0 ha
v.	Pervious area (open space)	:	7.0 ha
vi.	Slope of overland surface S	:	2%
vii.	Overland sheet flow path length	:	100m
viii.	Surface land condition	:	Poorly grassed
ix.	Proposed stormwater drainage	:	1.2 m (square concrete drain)
x.	Proposed drainage length	:	1.2 km
xi.	Friction slope of drainage	:	0.01

(a) Using **Table Q3(a)**, estimate peak flow for 2-year, 5-year and 10-year return period if it is considered as minor stormwater system.

(10 marks)

(b) Evaluate capability of proposed stormwater drainage to receive the post development peak flow by using **Table Q3(b)(i) and Table Q3(b)(ii)**.

(10 marks)

(c) Describe **TWO (2)** mitigation solutions to prevent an overflow in stormwater design system.

(5 marks)

Q4 (a) Comment on the importance of erosion and sediment control.

(6 marks)

(b) Based on Guidelines of Erosion and Sediment Control in Malaysia, recommend **TWO (2)** control facilities of erosion and sediment. Provide **ONE (1)** information each for suitable application and maintenance.

(12 marks)

(c) Considering design criteria of sediment basin for sediment control **(Table Q4(c)(i))** and **Table Q4(c)(ii),** recommend the setting zone of dry sediment basin for the construction area of 4.00 ha. Assume time of concentration of basin catchment is 20 minutes.

(7 marks)

-END OF QUESTIONS-

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Table Q1(b)(i)

Type of establishment	Unit/m^2/bays	Type of establishment	Unit/m^2/bays
Residential area	9000 unit	Hospital	500 beds
Commercial area	16000 m^2	Wet market	50 stalls
School	1000 students	Petrol kiosk	10 bays
School fully residential	550 students	Bus terminal	10 bays

Table Q1(b)(ii)

Type of Premises/Buildings	Average Daily Water Demand (Litres)
Low cost terrace house/ low cost flat	1100 /unit
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
Bungalow/condominium	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
Shop house (four storey)	4550/unit
Light industrial workshop	1500 /unit
Semi detached/ bungalow workshops	1500/unit
Building for heavy industry	65000/hectare
Building for medium industry	50000/hectare
Building for light industry	30000/hectare
Office/complex/commercial (domestic usage)	1000/100 square meter
Community centres or halls	1000/100 square meter
Hotel	1500/room
Education institution (other than school and kindergarden)	100/person
Day school/kindergarden	50/person
Fully residential school/ institution with higher learning with hostel facilities	250/person
Hospital	1500/bed
Mosque or other place of worship	50/person
Prison/ Army camp	250/person
Bus terminal	900/service bay
Petrol kiosk (with car washing bay)	50000/unit
Petrol kiosk (without car washing bay)	10000/unit
Stadium	55/persom

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Table Q2(b)

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 1 per residential student
Hospitals	4 per bed
Hotel with dining and laundry facilities	4 per room
Factories, excluding process water	0.3 per staff
Market (wet type)	3 per stall
Market (dry type)	1 per stall
Petrol kiosks/ service stations	15 per toilet
Bus terminal	4 per bus bay
Taxi terminal	4 per taxi bay
Mosque/ church/ temple	0.2 per person
Stadium	0.2 per person
Swimming pool or sports complex	0.5 per person
Public toilet	15 per toilet
Airport	0.2 per passenger/day 0.3 per employee
Laundry	10 per machine
Prison	1 per person
Golf course	20 per hole

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Table Q3(a)

Landuse	Runoff coefficient *C*	
	For minor system (≤ 10 year ARI)	For major system (> 10 year ARI)
Residential		
Bungalow	0.65	0.70
Semi-detached bungalow	0.70	0.75
Link and terrace house	0.80	0.90
Flat and apartment	0.80	0.85
Condominium	0.75	0.80
Commercial and business centres	0.90	0.95
Industrial	0.90	0.95
Sport fields, park and agriculture	0.30	0.40
Open spaces		
Bare soil (no cover)	0.50	0.60
Grass cover	0.40	0.50
Bush cover	0.35	0.45
Forest cover	0.30	0.40
Roads and highways	0.95	0.95
Water body (pond)		
Detention pond (with outlet)	0.95	0.95
Retention pond (no outlet)	0.00	0.00

Note: Runoff coefficients in this table are given as a guide for designers. Near-field runoff coefficient for any single or mixed landuse should be determined based on imperviousness of the area

Table Q3(b)(i)

Land surface	*n**
Paved	0.0150
Bare soil	0.0275
Poorly grassed	0.0350
Average grassed	0.0450
Densely grassed	0.0600

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Table Q3(b)(ii)

Surface type	Manning *n*
Short grass (< 150 mm)	0.0350
Tall grass (≥ 150 mm)	0.0500
Concrete smooth finish	0.0150
Concrete rough finish	0.0180
Stone pitching dressed stone in mortar	0.0170
Stone pitching random stone in mortar or rubble masonry	0.0350
Rock riprap	0.0300
Brickwork	0.0200
Pipe – vitrified clay	0.0120
Pipe – spun precast concrete	0.0130
Pipe – fibre reinforced cement	0.0130
Pipe – UPVC	0.0110

Table Q4(c)(i)

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 Q4(c)(ii)

Parameter	Time of Concentration of BasinCatchment (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

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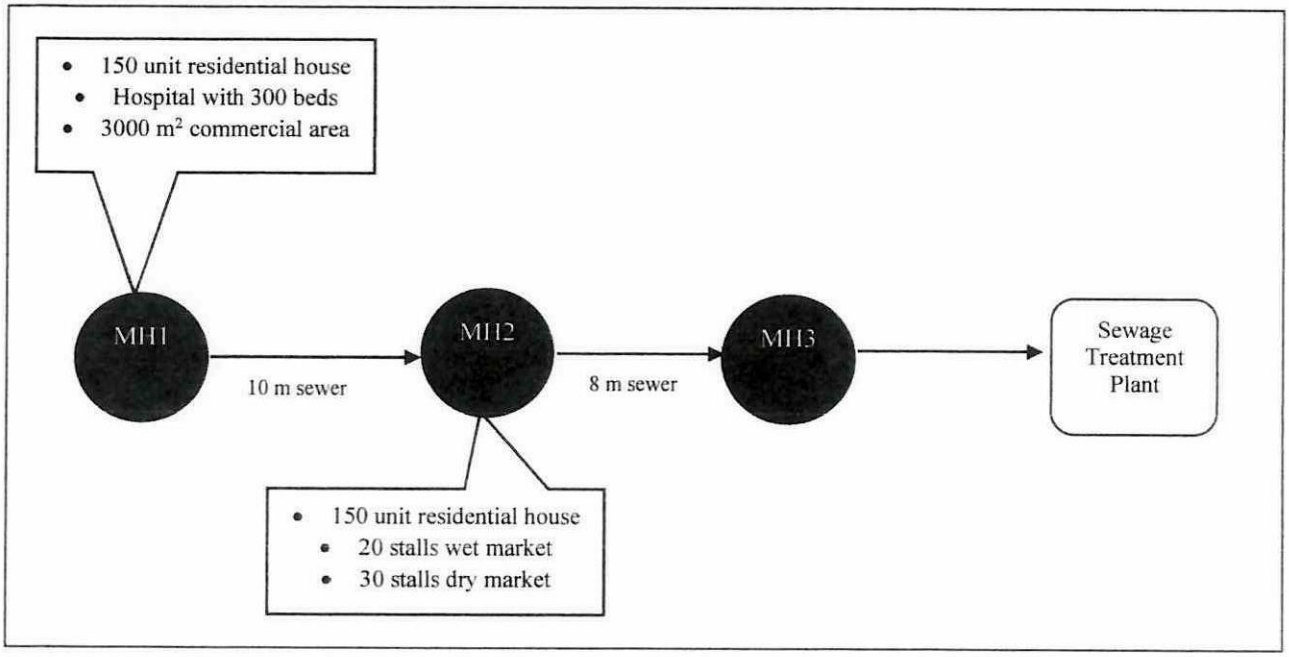

Figure Q2(b)

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USEFUL EQUATIONS

$$H_1 = \frac{10.666\, Q^{1.85} L}{C^{1.85} D^{4.87}}$$

where,

C = 130 ~ 140 (new pipe)

C = 120 (treated water pipe)

C = 90 ~ 100 (raw water pipe)

$$i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}} \qquad t_o = \frac{107 n^* L^{\frac{1}{3}}}{S^{\frac{1}{3}}} \qquad t_d = \frac{nL}{60 R^{\frac{2}{3}} S^{\frac{1}{2}}}$$

$$Q = CiA \qquad Q = \frac{1}{n} A R^{\frac{2}{3}} S_o^{\frac{1}{2}}$$

$4.7\,(PE/1000)^{-0.11}$