Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER I
## SESSION 2022/2023

| | | |
|---|---|---|
| COURSE NAME | : | DESIGN OF WASTEWATER ENGINEERING |
| COURSE CODE | : | BFA40403 |
| PROGRAMME CODE | : | BFF |
| EXAMINATION DATE | : | FEBRUARY 2023 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | 1. ANSWER ALL QUESTIONS.<br>2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.<br>3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK. |



THIS ANSWER SCHEME CONSISTS OF **SEVEN (7)** PAGES

**Q1** (a) Name **TWO (2)** standards or guidelines that should be referred to in designing a wastewater treatment plant in Malaysia.

(2 marks)

(b) Judge **THREE (3)** considerations that need to be considered when selecting the location prior to developing a wastewater treatment plant.

(6 marks)

(c) Evaluate the following data:

Peak flow, $Q_{peak} = 0.27\ m^3/s$
Clear opening between bars, = 25 mm
Flow through velocity, $v_h = 0.8$ m/s
Minimum channel depth, $D = 0.6$ m
Size of bar (width) = 10 mm

(i) Calculate the width and the depth of the bar screen chamber.

(4 marks)

(ii) By applying the answer obtained in **Q1(c)(i)**, calculate the number of bars, $n$ required for the bar screen.

(2 marks)

(iii) Check the total width of the channel once the $n$ is selected in **Q1(c)(ii)**.

(2 marks)

(d) Assess **THREE (3)** conditions of the interrelationship between water usage and wastewater flow as shown in **Figure Q1(d)**.

(9 marks)

**Q2** (a) **Figure Q2(a)** shows a schematic diagram of a facultative stabilization pond demonstrating the biochemical reactions of bacteria and algae. Distinguish the mechanism of waste treatment that takes place in the upper zone and lower zone in the facultative waste stabilization ponds.

(4 marks)

(b) Justify **TWO (2)** importance of detention time as a primary sedimentation basin design criterion.

(6 marks)

(c) As an engineer, you are assigned to design a velocity-controlled rectangular grit removal facility for peak design flow. Given, the design average flow and peak factor are 0.35 $m^3/s$ and 3, respectively. The horizontal and settling velocity and detention time are 0.3 m/s, 1.2 m/min, and 60 s, respectively. At this settling velocity, the minimum discrete particle of 0.18 mm diameter will be fully removed. A 25% allowance in the length of the channel is taken into account for turbulence at the influent and effluent structures. The calculations of the peak flow, surface area of a channel, theoretical length of the channel, width of the channel, cross-sectional area of the channel, depth of the channel and overall dimensions of the channel must be included in the design.

(15 marks)

**Q3** (a) Describe **THREE (3)** beneficial applications of chlorine in the disinfection process.

(3 marks)

(b) Sketch an overall processes flow diagram (including the sludge treatment option) for treating municipal wastewater with a high concentration of suspended solids, organic matter, and pathogens.

(10 marks)

(c) Permai Eco Park has to upgrade its primary wastewater treatment facility to a biological treatment plant. Therefore, they have selected a completely mixed-activated sludge system. Based on the existing primary plant data, the wastewater flow, $Q$ is 0.12 $m^3/s$ and $BOD_5$, $S_0 = 80$ mg/L.

Assuming the following values for the growth constants:
Allowable soluble $BOD_5$, $S = 15$ mg/L
$Ks = 88$ mg/L of $BOD_5$
$Y = 0.6$ mg VSS/ mg $BOD_5$ removed
$\mu_m = 3.5$/day
$kd = 0.05$/day

(i) Design the aeration tank by calculating the mean cell-residence time and the volume of the aeration tank, $V$, if the MLVSS = 2450 mg/L.

(9 marks)

(ii) Evaluate the changes in the volume of the activated sludge reactor if the detention time, $\theta$ is changed to 1 hour.

(3 marks)

**Q4** (a) Differentiate between raw sludge and anaerobically digested sludge in terms of their characteristics.

(8 marks)

(b) As an experienced engineer in the field of wastewater engineering, you are invited as a guest speaker for a seminar on "*Wastewater Treatments in Malaysia – Sludge Management*". Organise the outlines for your talk with regard to the sludge management practices in Malaysia to ensure you deliver a piece of comprehensive information to the audience. Your sharing must include an introduction to the sludge characteristics and types, the objective of sludge management, the treatment processes involved and the disposal methods of the treated biosolids.

(17 marks)

**– END OF QUESTIONS –**

**FINAL EXAMINATION**

SEMESTER/SESSION : SEM I / 2022/2023
COURSE NAME : DESIGN OF WASTEWATER ENGINEERING
PROGRAMME CODE : BFF
COURSE CODE : BFA40403

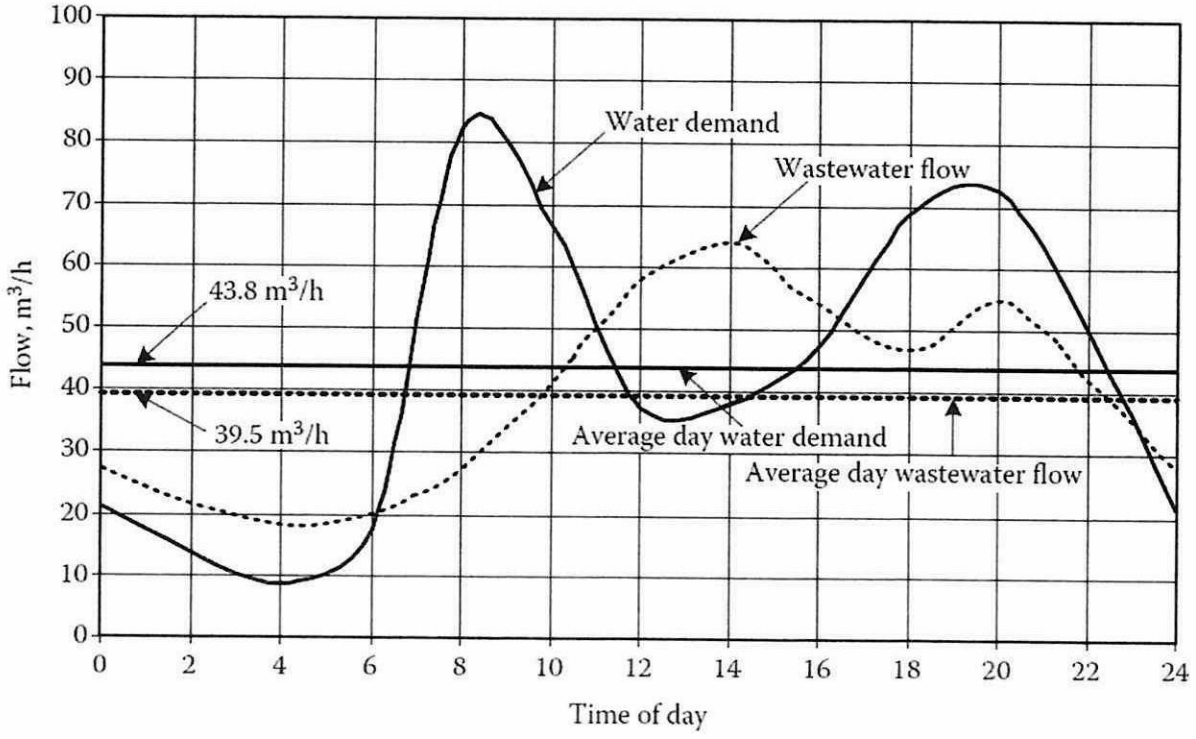


**FIGURE Q1(d)**

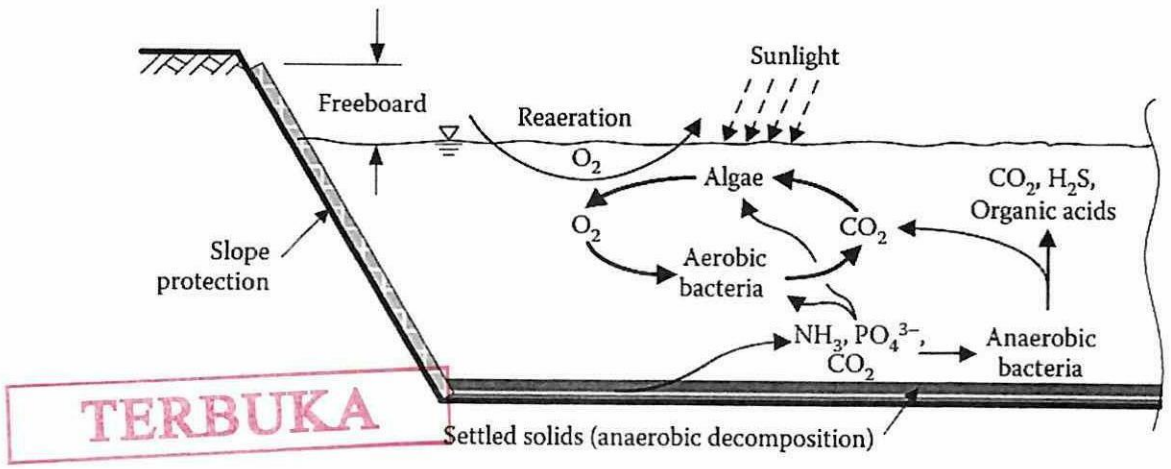




**FIGURE Q2(a)**

**FINAL EXAMINATION**

| | | | |
|---|---|---|---|
| SEMESTER/SESSION | : SEM I / 2022/2023 | PROGRAMME CODE | : BFF |
| COURSE NAME | : DESIGN OF WASTEWATER ENGINEERING | COURSE CODE | : BFA40403 |

## FORMULAE

$$A_s = \frac{Q_{peak}}{SLR} \qquad S = \frac{K_s\left(1+k_d\theta_c\right)}{\theta_c\left(\mu_m - k_d\right)-1} \qquad X = \frac{\theta_c\left(Y\right)\left(S_0 - S\right)}{\theta\left(1-k_d\theta_c\right)};\ \text{where } X = MLVSS$$

$$Q_{peak} = A_x \times v_h \qquad \theta = \frac{V}{Q}$$

Total width = Opening size ($n$+1) + size of bar ($n$)