Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESI 2019/2020

COURSE NAME	:	DESIGN OF WASTE WATER ENGINEERING
COURSE CODE	:	BFA 40403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Describe **TWO (2)** functions of equalization basin in wastewater treatment plant.
(2 marks)

(b) Explain the removal mechanisms of:

(i) Grit
(2 marks)

(ii) Oil and grease
(2 marks)

(c) The data of wastewater generated by a community on an hourly basis is recorded as shown in **Table Q1(c)**. Based on the following:

No. of unit = 2
Depth of equalization tank = 5 m
Length: width ratio = 2:1

Design **ONE (1)** unit equalization tank by measuring the following:

(i) Volume of equalization tank
(9 marks)

(ii) Surface area of the equalization tank and its dimensions
(10 marks)

Q2 (a) Name **FOUR (4)** zones in sedimentation tank.

(4 marks)

(b) A newly-constructed small town is required to provide a wastewater treatment plant with an estimation maximum daily flowrate of 45,500 m^3/d. Given the following values:

Darcy-Weisbach friction factor	= 0.03
Specific gravity	= 1.3
Diameter of particles	= 120 μm
Cohesion constant	= 0.05
Gravitational acceleration	= 9.81 m/s^2

(i) Calculate the scour velocity. Given, $v_{scour} = \left[\frac{8k(s-1)gd}{f}\right]^{\frac{1}{2}}$

(2 marks)

(ii) Calculate the peak flow horizontal velocity through the settling tank if **TWO (2)** tanks are to be provided. Each tank is having the width of 7 m and depth of 3 m.

(2 marks)

(iii) Recommend the state of settled matter in the settling tank based on the answers obtained in **Q2(b)(i)** and **Q2(b)(ii)**.

(2 marks)

(c) Justify the importance of determining scour velocity of primary sludge prior to the design of primary settling tank.

(3 marks)

(d) A new wastewater treatment plant needs to provide a circular sedimentation tank for an average design flow of 2700 m^3/d.

The design criteria for the sedimentation tank are as follows:

Peaking factor = 2.5
Peak surface overflow rate = 45 $m^3/m^2.d$
Average surface overflow rate = 20 $m^3/m^2.d$
Allowable peak weir loading = 150 $m^3/m.d$

Measure the following:

(i) Area of clarifier for average flow

(2 marks)

(ii) Area of clarifier for peak flow

 (2 marks)

(iii) Diameter of clarifier for peak flow

(2 marks)

(iv) Length of the weir for peak flow

(2 marks)

(v) Weir loading at peak flow. Then, comment on the obtained value.

(4 marks)

Q3 (a) Explain the following biological processes:

(i) Suspended growth culture

(2 marks)

(ii) Attached growth culture

(2 marks)

(b) Compare the difference between nitrification and denitrification processes.

(10 marks)

(c) Permai Park industrial area has to upgrade its primary wastewater treatment facility to a secondary plant. They have selected a completely mixed activated sludge system. Based on the data from the existing primary plant, the wastewater flow is 0.120 m^3/s and BOD_5, S_0 = 95.0 mg/L.

Assuming the following values for the growth constants:
Allowable soluble BOD_5, S = 15 mg/L
K_s = 90.0 mg/L BOD_5
Y = 0.50 mg VSS/ mg BOD_5 removed
μ_m = 2.5/day
k_d = 0.06/day

Calculate:

(i) Mean cell-residence time, θ_c

(3 marks)

(ii) Volume of the aeration tank, V if the MLVSS = 2175 mg/L

(4 marks)

Given:

$$S = \frac{K_s(1+k_d\theta_c)}{\theta_c(\mu_m - k_d)-1} \quad , \quad X = \frac{\theta_c Y + (S_0 - S)}{\theta(1+k_d\theta_c)}$$

(iii) Predict the changes of the volume of activated sludge reactor if the detention time, θ is changed to 1 hour.

(4 marks)

Q4 (a) Explain **TWO (2)** properties of disinfectants.

(4 marks)

(b) Illustrate with labelling the mechanism of pollutant removal by the following methods:

(i) Carbon adsorption

(4 marks)

(ii) Membrane ultrafiltration

(4 marks)

(c) Justify the importance of assessing the top water level for more intense storms up to 1 in 100 year storm events in the design of an outfall.

(3 marks)

(d) Secondary sludge needs to be properly treated prior to ultimate disposal.

(i) Illustrate and label the flow of sludge treatment processes.

(4 marks)

(ii) Review the difference between *chemical conditioning* and *heat treatment* in the process of sludge conditioning.

(6 marks)

– END OF QUESTIONS –

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TABLE Q1(c)

Time (h)	Cumulative Flow (m^3/hr) x 10^3
1	0.2
2	0.8
3	1.3
4	1.9
5	2.5
6	3.1
7	4.4
8	6.1
9	8.0
10	9.8
11	11.3
12	12.6
13	14.0
14	15.2
15	16.2
16	16.9
17	17.4
18	17.9
19	18.5
20	18.9
21	19.4
22	19.7
23	20.0
24	20.3