Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESI 2018/2019

COURSE NAME	:	DESIGN OF WASTE WATER ENGINEERING
COURSE CODE	:	BFA40403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Explain **TWO (2)** importances of grit and grease chambers in wastewater treatment plant.

(4 marks)

(b) Design a horizontal flow type grit chamber for the given criteria:

Estimated population	= 4800
Average sewage flows	= 20,000 m^3/d
Flow through velocity	= 0.25 m/s
Peaking factor	= 2.5
Minimum detention time	= 60 seconds
Width of the chamber is	= 1.2 m
Number of channel	= 2

Therefore, you have to provide the developer with the following information:

(i) Peak flow in one channel

(4 marks)

(ii) Cross sectional area of the channel

(3 marks)

(iii) Length of the channel

(2 marks)

(iv) Depth of the channel

(2 marks)

(v) Volume of one channel

(2 marks)

(vi) Surface loading rate for each channel at peak flow (as design checking). Given that the surface loading rate should be less than 1500 $m^3/m^2.d$ (according to *Guidelines for Developers Vol. 4 Sewage Treatment Plants*). Conclude whether the design is acceptable or not.

(3 marks)

(vii) Design summary with the overall dimensions (plan-view diagram)

(5 marks)

Q2 (a) Discuss **TWO (2)** principal benefits of flow equalization tank for biological treatment in wastewater treatment plant.

(2 marks)

(b) Grit is also removed in devices that use a vortex flow pattern. Demonstrate the total processes (mechanisms) happen in a vortex-type grit chamber to prevent grit from entering the subsequent wastewater treatment plant.

(4 marks)

(c) A small town is required to provide a small wastewater treatment plant with the peak daily flowrate is estimated to be 55,000 m^3/d. Calculate:

(i) Scour velocity, to determine if settled material will be resuspended using the following values: Cohesion constant, k = 0.05, specific gravity, s = 1.25, Gravitational acceleration, g = 9.81 m/s^2, diameter of particles, d = 100 μm and Darcy-Weisbch friction factor, f = 0.025.

Given: $V_H = \left[\frac{8k(s-1)gd}{f}\right]^{\frac{1}{2}}$

(3 marks)

(ii) Peak flow horizontal velocity through the settling tank if two (2) tanks are to be provided with the width of 6 m and depth of 4 m.

(3 marks)

(iii) Compare the values calculated scour velocity in **Q2(c)(i)** with the peak flow horizontal velocity through the settling tank calculated in **Q2(c)(ii)**. Then, comment on the difference between the values (if any).

(2 marks)

(d) The average flowrate at a small municipal wastewater treatment plant is 20 MLD while the peak daily flowrate is 50 MLD. Use a minimum of two clarifiers. Given that the overflow rate of 40 m^3/m^2.d, channel width of 6 m and the side water depth of 4 m. Design the rectangular clarifiers by calculating the following parameters:

(i) Required surface area for average flow condition

(3 marks)

(ii) Length of the tank for average flow condition

(2 marks)

(iii) Volume of the tank for average flow condition

(2 marks)

(iv) Overflow rate for peak flow condition

(2 marks)

(v) Detention time for peak flow condition

(2 marks)

Q3 (a) Explain **TWO (2)** main objectives of biological treatment of wastewater.

(3 marks)

(b) If BOD_5 of a wastewater sample measured is 250 mg/L (at 20°C) and the reaction constant, K (base e) is 0.35/d, calculate:

(i) Ultimate BOD, L_0

(3 marks)

(ii) 3-day BOD, L_3

(3 marks)

Given: $BOD_t = L_0(1 - e^{-Kt})$ and $L_t = L_0 e^{-Kt}$

(c) Sketch the schematic diagram of the processes involved in activated sludge system with appropriate labels.

(4 marks)

(d) Puteri Heights residential area has been directed to upgrade its primary wastewater treatment facility to a secondary plant. They have selected a completely mixed activated sludge system.

The following data are available from the existing primary plant:
Flow = 0.140 m^3/s
BOD_5 = 80.0 mg/L

Assuming the following values for the growth constants:
Allowable soluble BOD_5, S = 10 mg/L
K_s = 80 mg/L BOD_5
Y = 0.50 mg VSS/ mg BOD_5 removed
μm = 2.5/day
k_d = 0.050/day

Estimate:

(i) Mean cell-residence time, θ_c

(6 marks)

(ii) Volume of the aeration tank, V if the MLVSS = 2100 mg/L

(6 marks)

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

Q4 (a) Disinfection refers to the selective destructions of diseases-causing organisms. The purpose of disinfecting wastewater effluent is to protect public health by inactivating pathogenic organisms including enteric bacteria, viruses, and protozoans.

(i) Name **TWO (2)** chemical agents that commonly have been used as disinfectants.

(2 marks)

(ii) Explain **THREE (3)** properties of disinfectants.

(6 marks)

(b) Outfall is a discharge point of a waste stream into a body of water; alternatively it may be the outlet of a river, drain or a sewer where it discharges into the sea, a lake or the like. Outline **THREE (3)** considerations that need to be taken when designing an outfall for secondary effluent of wastewater.

(6 marks)

(c) There are several methods that can be applied in sludge management. Describe the following methods of sludge thickening:

(i) Gravity thickening

(2 marks)

(ii) Floatation thickening

(1 mark)

(iii) Mechanical thickening

(2 marks)

(d) Malaysia has a tropical climate. It has high temperatures and high humidity prevail, with an average temperature of 27°C. During the day, temperatures could rise above 30°C.

(i) Propose a suitable sludge treatment method for a to-be-constructed wastewater treatment plant which located in a hot climate country like Malaysia.

(2 marks)

(ii) Give your reasons upon your chosen method.

(4 marks)

– END OF QUESTIONS –