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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019**

COURSE NAME : DESIGN OF WASTE WATER
ENGINEERING

COURSE CODE : BFA40403

PROGRAMME CODE : BFF

EXAMINATION DATE : JUNE/JULY 2019

DURATION : 3 HOURS

INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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Q1 (a) Describe the characteristics of grit. (2 marks)

(b) Explain the significance of locating grit chambers ahead of wastewater pumps in the treatment plant. (2 marks)

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

Average sewage flows	= 18,000 m ³ /d
Peaking factor	= 2.5
Number of channel	= 2
Flow through velocity	= 0.3 m/s
Minimum detention time	= 60 seconds
Width of the chamber	= 1.3 m
Allowable surface loading rate (SLR)	= 1500 m ³ /m ² .d

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

- (i) Peak flow of sewage for the grit chamber (2 marks)
- (ii) Peak flow of sewage for one channel of the grit chamber (2 marks)
- (iii) Cross sectional area of the channel (2 marks)
- (iv) Length of the channel (2 marks)
- (v) Depth of the channel (2 marks)
- (vi) Volume of one channel (2 marks)
- (vii) Surface loading rate (SLR) for each channel at peak flow
(Compare the SLR value with the allowable SLR. Give comments). (4 marks)
- (viii) Plan-view diagram of the grit chamber with the dimensions (5 marks)

- Q2** (a) Name **TWO (2)** types of velocity and define the terms by sketching the diagram of settling path of a solid particle in a tank. (6 marks)
- (b) Assuming the diameter of a primary circular clarifier is 20 m and the wastewater flow rate of 10 MLD, calculate:
- (i) Surface area of the clarifier (2 marks)
- (ii) Surface loading rate of the clarifier (3 marks)
- (iii) Detention time (in hour) if the clarifier having a wastewater depth of 2.5 m (3 marks)
- (c) The average flowrate at Perbandaran Setia Jaya wastewater treatment plant is 28 MLD while the peak daily flowrate is 55 MLD. Use a minimum of two sedimentation tanks. Given that the overflow rate of $50 \text{ m}^3/\text{m}^2\cdot\text{d}$, channel width of 8 m and the side water depth of 3 m. Design the rectangular sedimentation tanks by calculate the following parameters:
- (i) Required surface area for average flow condition (2 marks)
- (ii) Length of the tank for average flow condition for one tank (2 marks)
- (iii) Volume of the tank for average flow condition for one tank (2 marks)
- (iv) Overflow rate for peak flow condition for one tank (2 marks)
- (v) Detention time (in hour) for peak flow condition for one tank (3 marks)

Q3 (a) Explain the following biological processes:

(i) Aerobic process (3 marks)

(ii) Anaerobic process (3 marks)

(b) 1700 m³/d of domestic wastewater flows with BOD₅ of 280 mg/L is treated in the conventional activated sludge plant reactor at 0.4 F/M ratio to obtain 85% BOD removal efficiency, calculate:

(i) Quantity of BOD loading in the reactor in kg/day (3 marks)

(ii) Amount of BOD removed in kg/day (3 marks)

(iii) Quantity of MLSS in the reactor in kg/day (3 marks)

(c) Maju Jaya Industrial Park is planning to upgrade its primary wastewater treatment facility to a secondary plant (completely mixed activated sludge system). The estimated wastewater flow is 0.155 m³/s and BOD loading, S₀ is 85 mg/L. Assuming the following values for the growth constants:

Allowable soluble BOD₅, S = 12 mg/L

K_s = 95.0 mg/L BOD₅

Y = 0.55 mg VSS/ mg BOD₅ removed

μ_m = 2.8/day

k_d = 0.055/day

Given:

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

Estimate:

(i) Mean cell-residence time, θ_c (5 marks)

(ii) Volume of the aeration tank, V if the MLVSS = 2175 mg/L (5 marks)

- Q4** (a) Describe the following methods of sludge thickening:
- (i) Flootation thickening (1 mark)
 - (ii) Gravity thickening (2 marks)
 - (iii) Mechanical thickening (3 marks)
- (b) Describe **TWO (2)** mechanisms of membrane filtration as tertiary wastewater treatment technology that commonly applied in developed countries. (5 marks)
- (c) By referring to **Figure Q4(c)**, explain the removal mechanism of solids in the waste stabilization pond. (8 marks)
- (d) Explain **THREE (3)** stages of anaerobic digestion in sludge treatment. (6 marks)

– END OF QUESTIONS –

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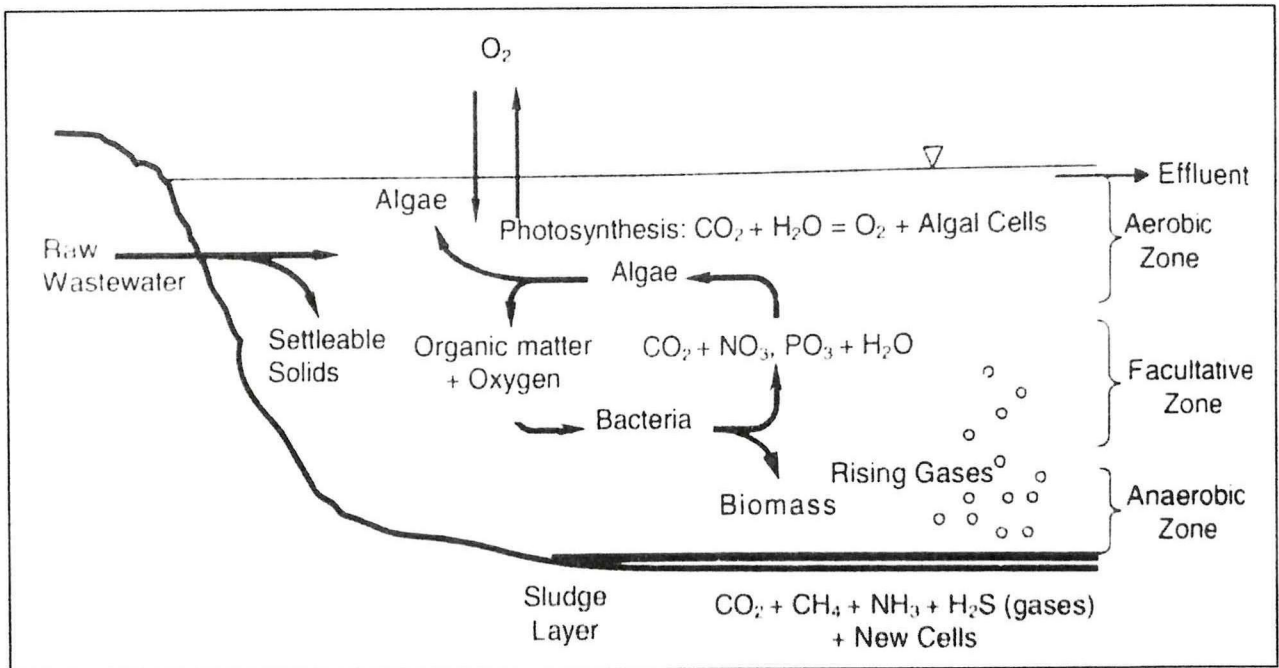


FIGURE Q4(c)

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