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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESI 2021/2022**

COURSE NAME : DESIGN OF WASTE WATER
ENGINEERING

COURSE CODE : BFA 40403

PROGRAMME CODE : BFF

EXAMINATION DATE : JANUARY / FEBRUARY 2022

DURATION : 3 HOURS

INSTRUCTION : 1. ANSWER **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS AN
ONLINE ASSESSMENT AND
CONDUCTED VIA **CLOSE BOOK**.

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

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- Q1** (a) Stormwater intrusion into manholes via manhole covers or soil infiltration is a significant issue for municipalities.
- (i) List **TWO (2)** significant issues caused by stormwater. (2 marks)
- (ii) Suggest **FOUR (4)** solutions to overcome this issue. (6 marks)
- (b) A city A with a predicted population of 55,000 people are dispersed across a 50-hectare. Assume an average water supply rate of 300 Lpcd and that only 75% of this total supply enters the sewer as wastewater.
- (i) Calculate the peak flow rate for a separate sewer line. (6 marks)
- (ii) Point out **FOUR (4)** water quantity components needed to be considered in analysing the net sewage quantity. (4 marks)
- (c) A meter that reads in cubic metres on the discharge side of a pump is read each morning as shown in **Table Q1(c)**, estimate the average m^3/min discharged from this pump for that period. (7 marks)
- Q2** (a) Choose **TWO (2)** types of flow devices for a residential area with a population equivalent of 4,500. (2 marks)
- (b) Sketch the aerated grit chamber (with labels). (3 marks)
- (c) A wastewater treatment plant is going to be developed for Makmur City residential area in April 2022. As an engineer, you are assigned to conduct preliminary design work for the sedimentation tank. Prepare the design calculations of the sedimentation tank using the following data:
- Population equivalent, PE = 15,750
Design flow rate = 225 L/cap.day
Length: Width > 3:1
Minimum number of sedimentation tank units = 2
Maximum SLR = $45 \text{ m}^3/\text{m}^2.\text{d}$
Detention time = 1.5 hours
Depth > 2.5 m
- Then, check whether the design is acceptable or not based on the above design criteria and sketch (with the dimensions labeled). (20 marks)

- Q3** (a) In a chlorination process, organic matter, ammonia, and reducing agents react with chlorine, thus reducing its effectiveness. State the other **FOUR (4)** factors that affect the efficiency of chlorination. (4 marks)
- (b) Outline considerations that should be taken into account when disposing of treated secondary effluent into recreational lakes. (6 marks)
- (c) Casa Jaya industrial 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 is $0.155 \text{ m}^3/\text{s}$ and $\text{BOD}_5, S_0 = 80.0 \text{ mg/L}$.

Assuming the following values for the growth constants:

Allowable soluble $\text{BOD}_5, S = 12 \text{ mg/L}$
 $K_s = 85.0 \text{ mg/L BOD}_5$
 $Y = 0.60 \text{ mg VSS/ mg BOD}_5 \text{ removed}$
 $\mu_m = 3/\text{day}$
 $k_d = 0.04/\text{day}$

- (i) Design the aeration tank by calculating the mean cell-residence time and the volume of the aeration tank if the $\text{MLVSS} = 2500 \text{ mg/L}$. (12 marks)
- (ii) Predict the changes of the volume of activated sludge reactor if the detention time, θ is changed to 1 hour. (3 marks)
- Q4** (a) Sketch the advanced wastewater treatment processes for industrial wastewater that integrate membrane filtration and ion exchange in the treatment system. (7 marks)
- (b) As an experienced engineer in the company, you are invited by Universiti Tun Hussein Onn Malaysia to give a talk on '*Mechanism and Processes involved in An Aerobic Digester of Sludge Treatment in Wastewater Treatment Plant*'. With the aid of **Figure Q4(b)**, plan your talk accordingly by summarizing all main points about the topic to assist your explanation. (8 marks)
- (c) As an engineer in a consultation company, you are assigned to advise a food processing manufacturer regarding the installation of membrane bioreactor (MBR) as an additional treatment technology following the recent proposal to upgrade the existing treatment system. However, the finance department of the manufacturer objected to the proposal for the following reasons:

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- Higher capital and operating costs than conventional systems have for the same throughput
- O&M costs include membrane cleaning and fouling control, as well as eventual membrane replacement.
- Energy costs are also higher because air scouring is needed to control bacterial growth on the membranes.

Based on the above reasons, you have to justify **FIVE (5)** benefits of membrane bioreactor installation that the manufacturer will get in terms of long term ROI (*return on investment*).

(10 marks)

– END OF QUESTIONS –

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FORMULAE

$$A_s = \frac{Q_{peak}}{SLR}$$

$$Q_{peak} = Q_{avg} \times PF$$

$$S = \frac{K_s (1 + k_d \theta_c)}{\theta_c (\mu_m - k_d) - 1}$$

$$PF = 4.7 \times p^{-0.11}$$

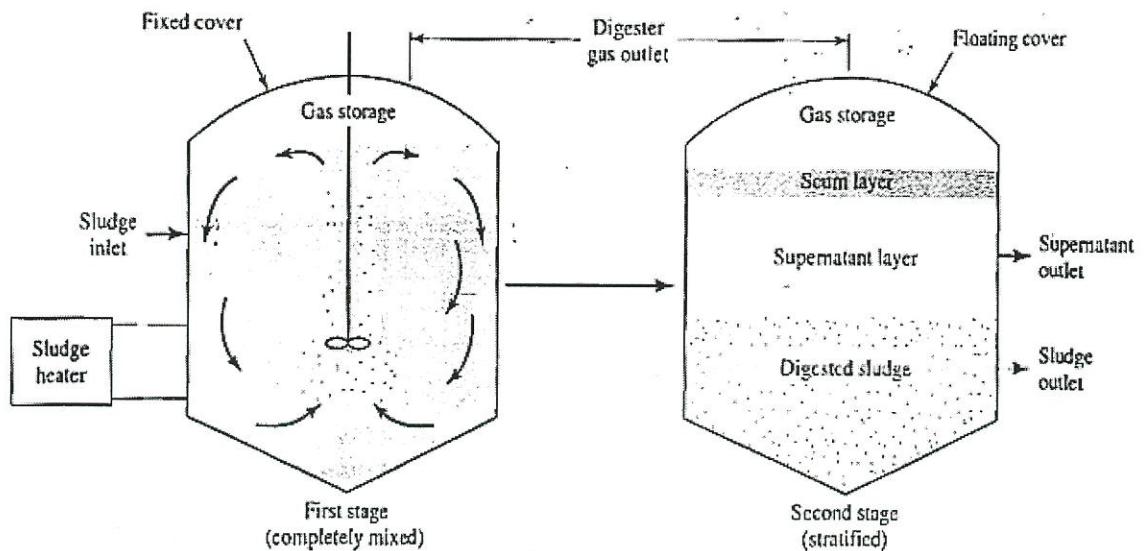
$$Q_{avg} = PE \times Q_{design}$$

$$X = \frac{\theta_c (Y) (S_0 - S)}{\theta (1 - k_d \theta_c)}$$

TABLE Q1(c)

Day	Time	Discharge volume (m ³)
Tuesday	8.20 AM	270,065
Wednesday	7.35 AM	270,601

FIGURE Q4(b)



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