Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

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

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) Describe **TWO (2)** advantages of considering minimum daily flow, average daily flow, and maximum daily flow data before designing processes for a wastewater treatment plant.

(4 marks)

(b) Justify the necessities of preserving the screening capacity of a bar rack throughout the entirety of its useful life by providing **THREE (3)** arguments.

(6 marks)

(c) A horizontal flow type grit chamber of two channels is proposed for a sewage treatment plant that will handle maximum sewage flow of 62,000 m^3/day. Design a horizontal flow type grit chamber, that comply with the recommended settling velocity of 0.2 m/s. Consider the flow-through velocity of 0.1 m/s and the width of each channel is 3m. Use allowable minimum detention time in a range of 3 to 4 minutes.

(15 marks)

Q2 (a) Discuss the factors that influence the settling velocity of particles in primary sedimentation tanks and explain how these factors can be controlled or manipulated to improve the efficiency of sedimentation.

(6 marks)

(b) Review the limitation of primary treatment in removing pollutant. Recommend **TWO (2)** secondary treatment technologies that are able to complement primary treatment and explain how they eliminate the primary treatment limitation.

(6 marks)

(c) Design a rectangular primary sedimentation tank to treat the sewage from population equivalent of 450,000 that comply with the surface loading rate of 45 m^3/m^2/day. Consider the sewage generation rate is 85% of the water supply (typically ranging between 250 to 300 Lpcd), number of tanks required is 3, length to width ratio of the rectangular tank is 3:1, and detention time of 2 hours.

(13 marks)

Q3 (a) Discuss the **THREE (3)** implications of a low food to microbe (F/M) ratio in a biological activated sludge reactor.

(6 marks)

(b) Compare UV irradiation and ozone treatment in disinfecting wastewater in terms of their effectiveness, residual of disinfection by-products, and factors that influence their effectiveness.

(9 marks)

(c) The conventional activated sludge process that adapted for sewage treatment was not efficiently remove the nitrogen and phosphorus as required by the Department of Environment (DOE) Malaysia. As a wastewater treatment plant engineer plan the efficient nutrients (nitrogen and phosphorus) removal for sewage treatment by providing information on suitable treatment processes, as well as their detailed mechanism on the removal of nutrients.

(10 marks)

Q4 (a) Explain in detail regarding the decision of using a 1 in 100-year storm event as the basis for assessing the extent of adverse impacts on the top water level of a receiving watercourse for an outfall design.

(4 marks)

(b) Review the following factors that need to be considered by the industry before deciding to reuse effluent:

i. Availability of natural water
ii. Quality and quantity of effluent, and cost of processing
iii. Industrial process water that does not involve public health considerations

(9 marks)

(c) Industrial wastewaters that contain heavy metals shall be treated to comply with Malaysia's Discharge Limits for Industrial Effluent based on Environmental Quality (Industrial Effluent) Regulations, 2009. Write specific impacts of heavy metals on the wastewater treatment processes and control strategies for addressing these micropollutants. Your writing will be used as the campaign material to urge industrial sector to remove heavy metal from the industrial wastewater efficiently.

(12 marks)

– END OF QUESTIONS –

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FORMULAE

$$Q_{peak} = A_x \times v_h \qquad L = v_h \times t \qquad D_{side\ water\ depth} = \frac{A_x}{W} \qquad D = \frac{A_x}{W}$$

$$D_{total} = D_{side\ water\ depth} + D_{freeboard} + D_{grit\ collection} \qquad Vol. = Q \times t \qquad SLR = \frac{Q}{A_s}$$

$$Q_{peak} = Q_{avg} \times PF \qquad \text{PF} = 4.7 \times \left(\frac{PE}{1000}\right)^{-0.11} \qquad Q_{peak} = Q_{avg} \times PF$$