Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018

COURSE NAME	:	WASTEWATER ENGINEERING DESIGN
COURSE CODE	:	BFA40403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2017 / JANUARY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) In general, the wastewater flowing to a wastewater treatment plant is divided into four wastewater types according to its source. List all **FOUR (4)** types of wastewater and give an example for each.

(5 marks)

(b) A mechanically cleaned screen has bars 5 mm thick and 30 mm clear spaces between the bars. If the velocity through the bars is 0.90 m/s, determine:

(i) approach velocity (2 marks)

(ii) head loss through the screen (3 marks)

(c) A municipal wastewater treatment plant has an average flow of 0.473 m^3/s, and two aerated grit chambers, are to be designed. Dual units should be provided for flexibility in operation, since one could be used when the other requires temporary maintenance. During normal operation, both chambers should be used. Each chamber is a rectangular tank with spiral-roll flow. Peak flow is 2.3 times the average flow. The tank width is 1.5 times the depth, and the length is 4.0 times the width. Determine:

(i) theoretical dimensions of the tanks, if the detention time is 3 minutes.

(7 marks)

(ii) total air flow, if 0.3 m^3/min per meter of tank length is to be provided.

(8 marks)

Q2 An in-line equalization tank is to be designed for a wastewater treatment plant. From plant records, a compilation has been made that register the hourly flowrate versus hour of the day as shown in **Table 1**. Calculate the size of in-line equalization tank required to equalize the flowrate and the time period when the equalization tank is empty. Provide a 20% excess capacity as a safety factor.

(25 marks)

Q3 (a) Describe each phase of microbial growth pattern as shown in **Figure Q3(a)**.

(5 marks)

(b) Assuming the food to microorganisms ratio equal to 0.35 and hydraulic residence time of 7 hours, compute the value of MLVSS to be maintained in the reactor of a conventional activated sludge plant designed to treat 7000 m^3/d settled wastewater with 230 mg/L of BOD_5.
Then, determine:

(i) volume of the reactor (2 marks)

(ii) daily amount of food (BOD_5) fed to the reactor (3 marks)

(c) A town has been directed to upgrade its primary wastewater treatment facility to a secondary plant that can meet an effluent standard of 25.0 mg/L BOD_5 and 25.0 mg/L suspended solids. A completely mixed activated sludge system had been selected. Assumed that BOD_5 of the suspended solids is estimated as equal to 60% of the suspended solids concentration. Two data below 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:
K_s = 80 mg/L BOD_5, μ_m = 2.5/day, k_d = 0.050/day.

Calculate:

(i) allowable soluble BOD_5 (5 marks)

(ii) mean cell-residence time (5 marks)

(iii) volume of the aeration tank (5 marks)

Q4 (a) Disinfection is used in wastewater treatment to kill pathogens (disease-causing microorganisms) present in wastewater that would cause mild to fatal illness if ingested. Chlorination is the most popular method applied for disinfection process. However, there are other methods of disinfection besides chlorination that can be applied in conventional and advanced wastewater treatment facility namely ozonation and ultraviolet (UV). Explain briefly the advantages and disadvantages of UV method for disinfection in wastewater treatment system.

(5 marks)

(b) Define these processes for sludge management:

(i) Thickening (2 marks)

(ii) Stabilization (2 marks)

(iii) Conditioning (2 marks)

(iv) Dewatering (2 marks)

(c) A primary circular clarifier for a municipal wastewater treatment plant is to be designed for an average flow of 7000 m^3/d. The regulatory agency criteria for primary clarifiers are as follows:

Peak overflow rate = 85 $m^3/m^2.d$
Average overflow rate = 35 $m^3/m^2.d$
Minimum side water depth = 2.5 m
Peak weir loading = 380 $m^3/m.d$
Ratio of the peak hourly flow to the average hourly flow is 2.5.

Determine:

(i) diameter of clarifier (5 marks)

(ii) peak weir loading (5 marks)

(d) Based on your calculations in **(c)**, compare and explain the calculated values with the regulatory criteria. (2 marks)

– END OF QUESTIONS –

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TABLE 1

Time	Flow, L/s	Time	Flow, L/s
12 am	275	12 noon	425
1	221	13 pm	405
2	164	14	385
3	130	15	351
4	105	16	326
5	99	17	326
6	119	18	328
7	204	19	365
8	354	20	399
9	411	21	399
10	425	22	329
11	430	23	345

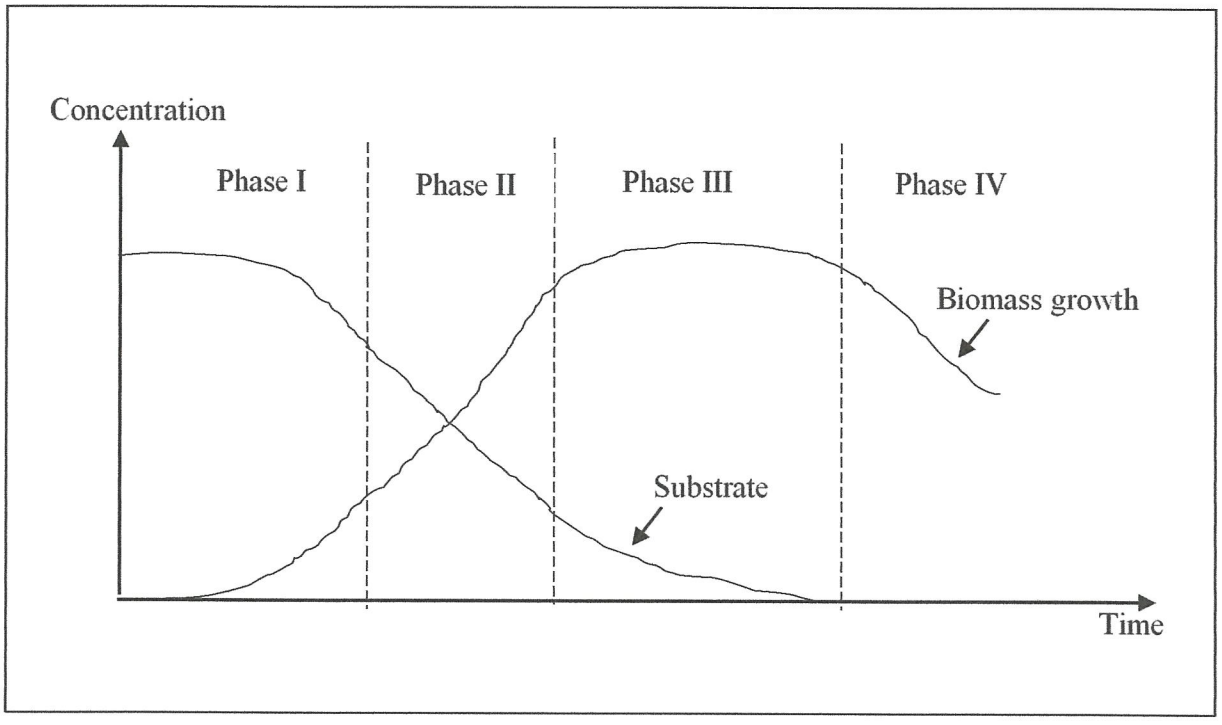

FIGURE Q3(a)