Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESI 2017/2018

COURSE NAME	:	WASTEWATER ENGINEERING DESIGN
COURSE CODE	:	BFA40403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE 2018 / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR(4)** QUESTIONS ONLY

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

Q1 (a) Describe briefly the possible adverse effects when untreated or partially treated wastewater is discharged to the environment.

(5 marks)

(b) Explain briefly advantages and disadvantages of the following wastewater collection system:

(i) Separate system. (3 marks)

(ii) Partially separate system. (3 marks)

(iii) Combined system. (3 marks)

(c) A city has a projected population of 60,000 spread over area of 50 hectare. Find the design discharge for the separate sewer line by assuming rate of water supply of 250 LPCD and out of this total supply only 75 % reaches in sewer as wastewater.

(8 marks)

Q2 (a) A manual bar screen is to be used in an approach channel with a maximum velocity of 0.60 m/s, and a design flow of 300 L/s. The bars are 10 mm thick and openings are 3 cm wide, the angle of inclination is 50°. Determine:

(i) The cross section of the channel, and the dimension needed if the tank depth is 1.5 times the width. (3 marks)

(ii) The velocity between bars. (3 marks)

(iii) The head loss in meters. (3 marks)

(iv) The number of bars in the screen. (3 marks)

(b) Design an aerated grit chamber for the treatment of municipal wastewater. The average flow rate is 60 MLD and the peaking factor is 2. Determine:

(i) The grit chamber volume if the average detention time at the peak flow rate is 3 minutes. Provide two chambers to facilitate periodic cleaning and maintenance.

(3 marks)

(ii) The dimensions of each grit chamber. Use a width-to-depth ratio of 1.2:1 and assume that the depth is 3 m.

(4 marks)

(iii) The detention time in each grit chamber at average flow.

(2 marks)

(iv) The air supply requirement. Assume that $0.3m^3$/min.m of length will be adequate.

(2 marks)

(v) The quantity of grit at peak flow. Assume a value of 0.015 $m^3/10^3$ m^3 at peak flow.

(2 marks)

Q3 (a) Explain briefly the purpose of providing primary sedimentation tank in wastewater treatment.

(5 marks)

(b) Determine the removal efficiency for a sedimentation basin with a critical velocity, V_o of 2 m/h in treating a wastewater containing particles whose settling velocities are distributed as given in **Table Q3** below. Plot the particle histogram for the influent and effluent wastewater.

Table Q3: Particles settling velocity

Settling Velocity (m/h)	**Number of Particles Per litre x 10^{-5}**
0.0-0.5	20
0.5-1.0	40
1.0-1.5	80
1.5-2.0	120
2.0-2.5	100
2.5-3.0	70
3.0-3.5	20
3.5-4.0	10

(20 marks)

Q4 A primary sedimentation tank for a municipal wastewater treatment plant is to be designed for an average flow of 7570 m^3/d. The regulatory agency criteria for primary sedimentation tanks are as follows: peak overflow rate = 89.6 $m^3/d\text{-}m^2$, average overflow rate = 36.7 $m^3/d\text{-}m^2$, minimum side water depth = 3 m, and peak weir loading = 389 m^3/d-m. The ratio of the peak hourly flow to the average hourly flow is 2.75. Determine:

(i) The diameter of the sedimentation tank.

(5 marks)

(ii) The length of the peripheral weir.

(5 marks)

(iii) The peak weir loading if peripheral weirs are used.

(5 marks)

(iv) The scour velocity if the diameter of particles is 100 μm. Use $s = 1.25$, $f = 0.025$, $g = 9.81$ m/s^2 and $k = 0.05$.

(5 marks)

(v) The removal rate of BOD and TSS at average and peak flow. Assume the empirical constants for BOD (a = 0.018, b = 0.020) and TSS (a = 0.0075, b = 0.014).

(5 marks)

Q5 Design a complete mixed activated sludge process aeration tank for treatment of 4 MLD sewage having BOD concentration of 180 mg/L. The effluent should have soluble BOD of 20 mg/L or less. Consider the following:

MLVSS/MLSS = 0.8
Return sludge SS concentration = 10000 mg/L
MLVSS in aeration tank = 3500 mg/L
Mean cell residence time adopted in design is 10 days

(25 marks)

– END OF QUESTIONS –