Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	DESIGN OF WASTEWATER ENGINEERING
COURSE CODE	:	BFA 40403
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) Explain the factors that will consider for selecting location of manhole.

(5 marks)

(b) State the significant physical, chemical and biological parameters to characterize wastewater.

(6 marks)

(c) Discuss the design criteria used to calculate the reactor volume and to evaluate the performance of biological processes.

(8 marks)

(d) A diameter of clarifier is 18.0 m and an average wastewater flow rate is 40.0 MLD. Calculate the hydraulic detention time and surface loading rate of a clarifier having a wastewater depth of 2.5 m in the clarifier.

(6 marks)

Q2 (a) Draw a flow diagram of a typical preliminary treatment system.

(3 marks)

(b) State **FOUR (4)** types of aerated grit chamber.

(4 marks)

(c) Explain advantages and disadvantages of the aerated grit chamber.

(6 marks)

(d) It is proposed to provide an aerated grit chamber for a treatment plant expecting an average of 10 MLD flow of domestic wastewater. Determine the dimensions of the grit chamber, the air requirement, and the quantity of grit to be removed.

Given:
Peak flow factor = 2.5
No. of chambers = 2 units
Depth of chamber = 2 m
Width-depth ratio = 1.5 : 1
An air supply rate = 0.3 m^3/min.m (length of chamber)
Grit settling = 0.15m^3 of grit per 1000m^3

(12 marks)

Q3 (a) Explain the principal factors that must be considered in the design of equalization basins

(5 marks)

(b) A treatment plant being designed for a new town requires an equalization basin to even out flow variations. **Table 2** shows the typical flow of the average variation over a day.

(i) Determine the equalization basin volume required for a uniform outflow equal to the average daily flow. Assume the flows are hourly averages and an addition of 25% to the estimated volume will be provided to account for contingencies.

(10 marks)

(ii) Design dimension of the equalization basin.

(10 marks)

Table 2 : Hourly flow pattern

Time (hours)	**Flow (m^3/s)**	**Time (hours)**	**Flow (m^3/s)**
0000	0.0481	1200	0.0718
0100	0.0359	1300	0.0744
0200	0.0226	1400	0.0750
0300	0.0187	1500	0.0781
0400	0.0187	1600	0.0806
0500	0.0198	1700	0.0843
0600	0.0226	1800	0.0854
0700	0.0359	1900	0.0806
0800	0.0509	2000	0.0781
0900	0.0631	2100	0.0670
1000	0.0670	2200	0.0583
1100	0.0682	2300	0.0526

Q4 (a) Discuss the significant factors that are normally considered in the design of aerobic biological process.

(10 marks)

(b) Explain the advantages of Sequencing Batch Reactor (SBR) system for municipal wastewater treatment.

(5 marks)

(c) An extended aeration system has been proposed to treat a wastewater flow of 500 m^3/d, with soluble BOD of 150 mg/l. Determine the concentration of soluble substate and the volume of aeration tank.
(Given: MLSS = 4000 mg/l, Yt = 0.4, Kd = 0.03 d-1, K =0.1 mg/l)

(10 maks)

Q5 (a) Explain the following processes for sludge treatment

(i) Preliminary operations
(ii) Thickening
(iii) Stabilization
(iv) Conditioning
(v) Dewatering

(10 arks)

(b) Explain the following processes in wastewater treatment plant

(i) Aerobic digestion
(ii) Anaerobic digestion.

(6 marks)

(c) Determine the daily volume of methane and total gas produced in an anaerobic digester that is operated at 35° C under the following conditions:

Biosolids flow = 300 m^3/d;
COD = 5,000 g/m^3 .
Y_{obs} = 0.04 g VSS/g COD
COD removal = 95%
Volume of methane gas = 65% of the total gas volume
COD of waste activated sludge = 1.42 of waste activated sludge produced (Px)
$P x = Y_{obs} Q (So - S)$

(9 marks)

- END OF QUESTION –

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SELECTION TABLE FOR FLOATING MECHANICAL AERATORS

Size, kW	OTR[b], kg/MJ	Nominal operating, depth, m	Complete mix zone, m	Complete O_2 dispersion zone, m
0.75	0.20	1.8	6	20
1.5	0.23	1.8	8	30
2.5	0.23	1.8	12	45
3.5	0.23	1.8	14	50
5.5	0.22	2.4	15	50
7.5	0.20	3.0	15	55
10	0.21	3.0	19	60
15	0.19	3.0	22	70
20	0.20	3.0	24	80
25	0.21	3.0	26	85

[a]These aerators are representative but do not represent actual choices. Actual manufacturers' data must be used for real world design.
[b]OTR = oxygen transfer rate

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FLOATING AERATOR DEPTH REQUIREMENTS