UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	WASTEWATER ENGINEERING
COURSE CODE	:	BFA 4043/BFA 40403
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGTH (8)** PAGES.

Q1 (a) Explain briefly the following terms:

(i) Population equivalent
(ii) Average flow
(iii) Peak flow
(iv) Minimum flow
(v) Organic loading rate

(10 marks)

(b) The proposed new town will be completed with the following facilities as shown in **Table 1.**

Table 1: Recommended Population Equivalent

No.	Type of Premises	Quantity
1	Bungalow house	40 units
2	Terrace house	200 units
3	Apartment house	80 units
4	Shopping house	3360 m^2
5	Shopping complex	2500 m^2
6	Primary school (daily)	400 students
7	Secondary school (daily)	600 students
8	Wet market	100 stalls
9	Public toilet	10 toilets
10	Petrol station	4 toilets

(i) Determine the population equivalent (PE) of the new town.
(ii) If the domestic wastewater contribution is taken as 225 l/day.capita, determine the average flow.
(iii) Determine the peak flow, if peak factor $= 4.7(PE/1000)^{-0.11}$

(15 marks)

Q2 (a) State **FOUR (4)** types of aerated grit chamber.

(4 marks)

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

(6 marks)

(c) Design the dimension, velocity across bottom of chamber, grit volume and depth of grit hoper for an aerated grit chamber, wastewater treatment plant. Given:

The peak flowrate = 104,000 m^3/d
Width and depth ratio = 1:1.33
Wastewater depth = 4 m
Hydraulic retention time = 30 min
Submergence, S = 2.35 m
Total air flow rate, Af = 0.0019 $m^3/s.m$
Dimension coefficient, K = 0.7 m.s
Opening under the baffle, d_b = 0.65 m
Quantity of the grit = 0.2 m^3 grit/1000 m^3 flow
Width of grit hopper = 1 m
Velocity across bottom of chamber, $v_b = (SA_f/Kd_b)^{1/2}$

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

(5 marks)

(b) Design the volume and dimensions of an SBR for the new town using the following design data:

Design flow rate = 22,700 m^3/d
MLSS = 3,000 mg/L,
The settled sludge = 6,000 mg/L.
Clear liquid volume above the sludge blanket = 35%
Depth of tank = 6 m
Number of tanks = 2
Anoxic fill = 135 min
Aerated fill = 45 min
React = 90 min
Settle = 45 min
Decant = 30 min
Idle = 15 min

(20 marks)

Q5 (a) Explain the following processes for sludge treatment

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

(10 marks)

(b) The anaerobic sludge digestion is one of the most widely used method to decompose and stabilize the organic and inorganic content of the sludge. Discuss briefly the digestion processes occur in the system in stages of hydrolysis, acidogenesis and methanogenesis.

(6 marks)

(c) The sludge production having 96% moisture content from a wastewater treatment plant is 1000 kg on dry solid basis. The solid contain 70% volatile matter with a specific gravity of 1.02 and 30% mineral matter with a specific gravity of 2.5. Determine the volume of raw and digested sludge if reduction in volatile solid is 55% during digestion and moisture content of digested sludge is 92%.

(9 marks)

- END OF QUESTION -

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POPULATION EQUIVALENT

No.	Type of Premise/Establishment	Population Equivalent (recommended)
1	Residential	5 per unit
2	Commercial: (includes entertainment/recreational centres, restaurants, cafeteria, theatres)	3 per 100 gross area
3	School/Educational Institutions: - Dry school/institutions - Fully residential - Partial residential	 0.2 per student 1 per student 0.2 per student for non-residential student and 1 per student for residential student
4	Hospitals	4 per bed
5	Hotels (with dining and laundry facilities)	4 per room
6	Factories (excluding process waste)	0.3 per staff
7	Market (wet type)	0.3 per stall
8	Petrol kiosks/Service stations	18 per service bay
9	Bus terminal	4 per bus bay

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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