UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESI 2012/2013

COURSE NAME	:	WASTEWATER ENGINEERING
COURSE CODE	:	BFA 40403
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	DECEMBER 2012/JANUARY 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTION ONLY

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES.

Q1 (a) Briefly explain the following terms:

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

(10 marks)

(b) Explain the following principles for the siting of wastewater treatment plant.

(i) Buffer zone
(ii) Siting criteria
(iii) Environmental impact assessment
(iv) Hazard and operability studies.

(10 marks)

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

(5 marks)

Q2 (a) State **five (5)** types of racks and screens. Explain the typical use of each component in wastewater treatment plant.

(5 marks)

(b) Design the headlosses, the number of bars and the effective area of the screen openings for a bar rack for New Coastal City with a clean bar rack and with partial blockage of the screen. Given:

The peak hour flow rate = 104,000 m^3/d
The approach velocity = 0.53 m/s
Bar width = 15 mm.
Depth of screen = 1.4 m
Bar spacing = 20 mm.
Differential headloss for activation of the cleaning rakes = 150 mm.
Maximum flow area blockage to initiate continuous operation of rakes = 50%.
The discharge coefficient = 1.67 for a clean screen
The discharge coefficient = 1.43 for a partially clogged screen.

(20 marks)

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

(5 marks)

(b) A treatment plant being designed for New Coastal City requires an equalization basin to even out flow and BOD variations. The following flows and BOD_5 have been found to be typical of the average variation over a day **(Table 1).**

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

(8 marks)

(ii) Evaluate the impact of equalization on the mass loading of BOD_5.

(12 marks)

Table 1: Flows and BOD_5 for the average variation over a day

Time (hour)	**Flow (m^3/s)**	**BOD_5 (mg/L)**	**Time (hour)**	**Flow (m^3/s)**	**BOD_5 (mg/L)**
0000	0.0481	110	1200	0.0718	160
0100	0.0359	81	1300	0.0744	150
0200	0.0226	53	1400	0.0750	140
0300	0.0187	35	1500	0.0781	135
0400	0.0187	32	1600	0.0806	130
0500	0.0198	40	1700	0.0843	120
0600	0.0226	66	1800	0.0854	125
0700	0.0359	92	1900	0.0806	150
0800	0.0509	125	2000	0.0781	200
0900	0.0631	140	2100	0.0670	215
1000	0.0670	150	2200	0.0583	170
1100	0.0682	155	2300	0.0526	130

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 of Coastal City 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) 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)

S1 (a) Secara ringkas beri takrifan istilah-istilah berikut:

(i) Hayat rekabentuk
(ii) Setara Penduduk
(iii) Aliran purata
(iv) Aliran pucak
(v) Kadar beban organik

(10 markah)

(b) Terangkan prinsip-perinsip berikut untuk penapakan loji rawatan air sisa.

(i) Zon penimbal
(ii) Kriterium penapakan
(iii) Penilaian impak alam sekitar
(iv) Kajian bahaya and keboleh-kendalian

(10 markah)

(c) Terangkan faktor-faktor yang perlu dipertimbangkan untuk pemilihan kawasan lurang.

(5 markah)

S2 (a) Nyatakan **lima (5)** jenis rak dan penapis. Terangkan kegunaan tipikal bagi setiap koponen dalam loji rawatan air sisa.

(5 markah)

(b) Rekabentuk kehilangan turus, bilangan bar dan keluasan berkesan bagi penapis terbuka untuk bar rak bagi Bandar New Coastal dengan rak bar bersih dan penapis penyekat separa. Diberi:

Kadar aliran jam puncak = 104,000 m^3/d
Halaju tuju = 0.53 m/s
Lebar bar = 15 mm
Kedalaman penapis = 1.4 m
Jarak antara bar = 20 mm
Perbezaan kehilangan turus untuk rak bersih pengaktifan = 150 mm
Aliran maksimum kawasan penyekat kepada operasi rak berterusan awal = 50%
Pekali kadar alir = 1.67 untuk penapis bersih
Pekali kadar alir = 1.43 untuk penapis separa sumbat.

(20 markah)

S3 (a) Terangkan faktor-faktor penting yang masti dipertimbangkan dalam merekabentuk tangki pengimbangan.

(5 markah)

(b) Satu loji rawatan air sisa direka-bentuk untuk Bandar New Coastal memerlukan satu tangki pengimbangan bagi perubahan aliran keluar dan BOD. Berikut merupakan aliran dan BOD_5 didapati nilai tipikal perubahan purata sepanjang hari. (**Jadual 1**)

(i) Tentukan isipadu tangki pengimbangan yang diperlukan untuk aliran keluar seragam yang sama dengan aliran purata harian. Andaian aliran jam purata dan penambahan sebanyak 25% kepada isipadu dikira yang akan sediakan dalam pengiraan untuk kontingensi.

(8 markah)

(ii) Nilaikan impak pengimbangan ke atas beban jisim BOD_5

(12 markah)

Jadual 1: Aliran dan BOD_5 untuk perubahan purata sepanjang hari

Masa (jam)	**Aliran (m^3/s)**	**BOD_5 (mg/L)**	**Masa (jam)**	**Aliran (m^3/s)**	**BOD_5 (mg/L)**
0000	0.0481	110	1200	0.0718	160
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S4 (a) Terangkan kelebihan sistem reaktor *Sequencing Batch* (SBR) untuk rawatan air sisa perbandaran.

(5 markah)

(b) Rekabentukkan isipadu dan dimensi SBR untuk bandar baru *Coastal City* dengan menggunakan data rekabentuk berikut:

Kadar aliran rekabentuk = 22,700 m^3/d
MLSS = 3,000 mg/L
Enapcemar termendap = 6,000 mg/L
Isipadu cecair bersih di atas selimut enapcemar = 35%
Kedalaman tangki = 6m
Bilangan tangki =2
Masa mengisi Anosik = 135 min
Masa mengisi udara = 45 min
Masa tindakbalas = 90 min
Masa mendap = 45 min
Masa menyiring = 30 mim
Masa melahu = 15 min

(20 markah)

S5 (a) Terangkan proses berikut untuk rawatan enapcemar

(i) Operasi preliminari
(ii) Pemekatan
(iii) Pengstabilan
(iv) Penyesuaian
(v) Penyahairan

(10 markah)

(b) Terangkan proses berikut dalam loji rawatan air sisa

(i) Penguraian aerobik
(ii) Penguraian anaerobik

(6 markah)

(c) Tentukan isipadu metanol dan jumlah gas harian yang dihasilkan dalam pengurai anaerobik pada suhu operasi 35° di bawah keadaan berikut:

Aliran biopepejal = 300m^3/d
COD = 5,000 g/m^3
Y_{obs} = 0.04 g VSS/g COD
Penyingkiran COD = 95%
Isipadu gas metanol = 65% daripada jumlah isipadu gas
COD sisa enapcemar teraktif = 1.42 sisa enapcemar teraktif yang dihasil (Px)
$P x = Y_{obs} Q (So - S)$

(9 markah)