UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2009/2010

SUBJECT NAME	:	ENVIRONMENTAL ENGINEERING
SUBJECT CODE	:	BFC 3103
COURSE	:	3BFF
EXAMINATION DATE	:	NOVEMBER 2009
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER FIVE (5) QUESTIONS ONLY

THIS PAPER CONSIST OF TEN (10) PAGES ONLY

Q1 (a) Expain briefly the following physical characteristics of water quality:

   (i)   Turbidity
   (ii)   Color
   (iii) Taste and Odor
   (iv)   Temperature

   (4 marks)

(b) Gives four (4) reasons why Total Coliform Test is selected as the test for microorgismes in water treatment.

   (8 marks)

(c) Explain briefly the following Environmental Legislation and Regulations:

   (i)   Environmental Quality Act, 1974
   (ii)   Sewerage Services Act, 1993
   (iii) Waters Act 1920 (Revised 1989)
   (iv)   The Water Supply Enactment (1955)

   (8 marks)

Q2 (a) Explain the difference between point source and non-point source of water pollution.

   (4 marks)

(b) Explain the procedure for determining BOD and specify the nominal values of temperature and time used in the test.

   (6 marks)

(c) Town A discharges 0.126 m^3/s of treated wastewater into river. The BOD$_5$ of the wastewater is 34 mg/L. River has a 10-year, 7-day low flow of 0.126m^3/s. Upstream of the wastewater out-fall from town A, the BOD$_5$ is 1.2 mg/L. The BOD rate constants k are 0.222 d^{-1} and 0.090d^{-1} for the wastewater and the river respectively. The temperature of both the river and the wastewater is 20°C. Calculate the initial ultimate BOD after mixing.

   (10 marks)

2

Q3 (a) Explain the difference between coagulation and flocculation.

(4 marks)

(b) Two set of such jar tests were conducted on a raw water and the data as given below. Find the optimal pH, coagulant dose and alkalinity that would be consumed at the optimal dose (expressed as $CaCO_3$).

Table 1: Jar Test

Test	1			2		
Parameter/ Beakers	pH	Alum Dose (mg/L)	Turbidity (NTU)	pH	Alum Dose (mg/L)	Turbidity (NTU)
1	5.0	10	11	6.0	5	14
2	5.5	10	7	6.0	7	9.5
3	6.0	10	5.5	6.0	10	5
4	6.5	10	5.7	6.0	12	4.5
5	7.0	10	8	6.0	15	6
6	7.5	10	13	6.0	20	13

(10 marks)

(c) Determine the lime dose, in mg/L as $CaCO_3$ to soften the following water to a final hardness of 70.0 mg/L as $CaCO_3$. The ion concentration reported below are all as $CaCO_3$.

$$Ca^{2+} = 220.0$$
$$Mg^{2+} = 75.0$$
$$HCO_3^- = 265.0$$
$$CO_2 = 17.0$$

(6 marks)

Q4 (a) States four (4) processes of primary treatment in wasterwater treatment plant.

(6 marks)

(b) A treatment plant being designed requires an equalization basin to even out flow. The following data has been recorded. Determine size of the equalization basin if a 25% excess capacity is provided.

3

Table 2: Flow rate data collection

Time	Flow, $(x10^{-3}m^3/s)$	Time	Flow, $(x\ 10^{-3}m^3/s)$
0000	12	1200	41
0100	11	1300	41
0200	09	1400	42
0300	09	1500	38
0400	09	1600	33
0500	13	1700	39
0600	18	1800	46
0700	26	1900	46
0800	33	2000	44
0900	39	2100	34
1000	47	2200	31
1100	44	2300	20

(14 marks)

Q 5 (a) Distinguish between suspended growth and attached growth processes in wastewater treatment.

(5 markah)

(b) An activated slugde wastewater treatment plant (WWTP) has been designed for 5000 m^3/d domestic wastewater that can meet an efluent standard of 20 mg/L BOD_5 and 20 mg/L SS. The BOD_5 of influent is 175 mg/l. Determine the volume of the aeration tank and food to microorganism ratio (F/M ratio). Asuming that BOD_5 of the SS is equal to 63 percent of the SS effluent concentration and MLSS is 2500 mg/L.

(Given: Ks = 60 mg/L BOD5, μ_m = 3 d^{-1}, k_d = 0.1 d-1 , Y = 0.6 mg VSS/mg BOD_5)

(15 marks)

4

Q6 (a) Processing and separation of solid waste a very important activity in integrated solid waste management;

   (i) What is meant by solid waste processing and separation and where does this activity takes place?

   (ii) List five (5) materials components of solid waste that are separated and processed and why the materials have to be separated?
   (7 marks)

(b) A transfer station is going to be built to manage solid waste produced by a town consisting of few residential areas, a commercial center and an industrial estate. Perform an analysis regarding the advantages and disadvantages of constructing a transfer station for that town.
   (7 marks)

(c) A community of 25,000 people generates solid waste at a rate of 2 kg per person per day. It is compacted in a sanitary landfill to a unit weight of 1000 kg/m^3. After 1 year of operation, to what depth will a 10 hectare landfill be covered? Assume a MSW-to-cover ratio of 4:1.
   (6 marks)

Q7 (a) Explain the following health effects of air pollution:

   (i) Carbon Monoxide (CO)
   (ii) Nitrogen Dioxide (NO$_2$)
   (iii) Sulfur Oxide (SO$_x$)
   (iv) MP$_{10}$
   (6 marks)

(b) Explain the factors affecting dispersion of air pollutants.
   (4 marks)

(c) Determine the efficiency of a standard cyclone having the following characteristics for particles 10 μm in diameter with a density of 800 kg/m^3:

   Cyclone barrel diameter = 0.50
   Gas flow rate = 4.0 m^3/s
   Gas temperature = 25°C
   (10 marks)

S1 (a) Terangkan ciri-ciri fizikal kualiti air berikut:

      (i)   Kekeruhan
      (ii)   Warna
      (iii)   Rasa dan bau
      (iv)   Suhu

(4 markah)

(b) Berikan empat (4) sebab kenapa ujian total coliform dipilih sebagai ujian microorganisma untuk rawatan air bersih.

(8 markah)

(c) Terangkan secara ringkas perundangan dan peraturan alam sekitar berikut:

      (i)   Akta kualiti Alam Sekitar 1974
      (ii)   Akta perkhidmatan pembentungan 1993
      (iii)   Akta Air 1920 (pindaan 1989)
      (iv)   Enakmen bekalan air (1955)

(8 markah)

S2 (a) Terangkan perbezaan antara sumber titik dan sumber bukan titik bagi pencemaran air.

(4 markah)

(b) Terangkan prosedur untuk menentukan BOD and tentukan nilai nominal suhu dan masa digunakan dalam ujian tersebut.

(6 markah)

(c) Bandar A melepaskn 0.126 m³/s air sisa terawat ke dalam sungai. BOD_5 air sisa tersebut adalah 34mg/L. Aliran cuaca kemarau suatu sungai (berciri hujan 10 tahun dan 7 hari) ialah o.126 m³/s. BOD_5 1.2 mg/L dihulu ketika curahan air sisa ialah 1.2 mg/L. Kadar angkatap BOD, k bagi air sisa dan sungai masing-masing ialah $0.222d^{-1}$ and $0.090d^{-1}$. Suhu untuk sungai dan air sisa ialah 20°C. Kira BOD muktamat selepas campuran.

(1C markah)

S3   (a)   Terangkan perbezaan antara pengentalan dan pemberbukuan.

(4 markah)

(b)   Dua set ujian jar dilakukan ke atas sampel air mentah dan datanya ujian adalah seperti dalam jadual di bawah ini. Kira pH optima, dos pengental dan kealkalian pada dos optima (dalam setara $CaCO_3$).

Jadual 1:Ujian Jar

Test	1			2		
Parameter/ Beakers	pH	Alum Dose (mg/L)	Turbidity (NTU)	pH	Alum Dose (mg/L)	Turbidity (NTU)
1	5.0	10	11	6.0	5	14
2	5.5	10	7	6.0	7	9.5
3	6.0	10	5.5	6.0	10	5
4	6.5	10	5.7	6.0	12	4.5
5	7.0	10	8	6.0	15	6
6	7.5	10	13	6.0	20	13

(10 markah)

(c)   Kira dos kapur, dalam mg/L setara $CaCO_3$ untuk melembutkan air ke tahap kekerasan terakhir 70.0 mg/L $CaCO_3$. Kepekatan ion mg/L dalam setara $CaCO_3$ ialah seperti berikut:

$$Ca^{2+} \quad = \quad 220.0$$
$$Mg^{2+} \quad = \quad 75.0$$
$$HCO_3^- \quad = \quad 265.0$$
$$CO_2 \quad = \quad 17.0$$

(6 markah)

S4   (a)   Nyatakan empat (4) proses rawatan peringkat primer dalam loji olahan air sisa.

(6 marks)

(b)   Sebuah loji olahan air sisa memerlukan sebuah tangki pengimbang bertujuan untuk menyeragamkan kadar alir. Berikut adalah nilai kadar alir sepanjang hari. Kira saiz tangki pengimbang, dalam unit meter padu, jika keupayaan tangki ditambah 25%.

Jadual 2: Pengumpulan Data Kadar Alir

Masa	Kadar alir, $(\times 10^{-3} m^3/s)$	Masa	Kadar alir, $(\times 10^{-3} m^3/s)$
0000	12	1200	41
0100	11	1300	41
0200	09	1400	42
0300	09	1500	38
0400	09	1600	33
0500	13	1700	39
0600	18	1800	46
0700	26	1900	46
0800	33	2000	44
0900	39	2100	34
1000	47	2200	31
1100	44	2300	20

(14 marks)

S5 (a) Terangkan perbezaan antara proses kultur terampai dan kultur terlekat.

(5 markat)

(b) Loji olahan air sisa enap cemar teraktif direka-bentuk untuk 5000 m³/d air sisa domestik yang boleh mencapai piawai effluent 20 mg/L BOD$_5$ dan 20 mg/L SS. BOD$_5$ influen ialah 175 mg/L. Tentukan isipadu tangki pengudaraan dan nisbah makanan kapada microorganisma (nisbah F/M). Andaian BOD$_5$ bagi SS ialah bersamaan dengan 63 peratus daripada kepekatan effluen SS dan nilai MLSS ialah 2500 mg/L.
(Diberi: Ks = 60 mg/L BOD5, μ_m = 3 d^{-1}, k$_d$ = 0.1 d^{-1}, Y = 0.6 mg VSS/mg BOD$_5$)

(15 markah)

Jadual 2: Pengumpulan Data Kadar Alir

Masa	Kadar alir, $(x10^{-3}m^3/s)$	Masa	Kadar alir, $(x\ 10^{-3}m^3/s)$
0000	12	1200	41
0100	11	1300	41
0200	09	1400	42
0300	09	1500	38
0400	09	1600	33
0500	13	1700	39
0600	18	1800	46
0700	26	1900	46
0800	33	2000	44
0900	39	2100	34
1000	47	2200	31
1100	44	2300	20

(14 marks)

S5　(a)　Terangkan perbezaan antara proses kultur terampai dan kultur terlekat.

(5 markat)

(b)　Loji olahan air sisa enap cemar teraktif direka-bentuk untuk 5000 m^3/d air sisa domestik yang boleh mencapai piawai effluent 20 mg/L BOD_5 dan 20 mg/L SS. BOD_5 influen ialah 175 mg/L. Tentukan isipadu tangki pengudaraan dan nisbah makanan kapada microorganisma (nisbah F/M). Andaian BOD_5 bagi SS ialah bersamaan dengan 63 peratus daripada kepekatan effluen SS dan nilai MLSS ialah 2500 mg/L.

(Diberi: Ks = 60 mg/L BOD5, μ_m = 3 d^{-1}, k_d = 0.1 d^{-1} ,Y = 0.6 mg VSS/mg BOD_5)

(15 markah)

8

S6 (a) Pemprosesan dan pemisahan bahan-bahan yang terdapat dalam sisa pejal adalah satu aktiviti yang amat penting di dalam pengurusan sisa pejal bersepadu;

(i) Apakah yang dimaksudkan dengan pemprosesan dan pemisahan sisa pejal dan dimanakan aktiviti ini boleh dilakukan?

(ii) Nyatakan lima (5) komponen bahan sisa pejal yang biasa dipisahkan dan mengapa bahan-bahan ini perlu dipisahkan?.

(7 markah)

(b) Sebuah stesen pemindahan sisa pejal akan dibina bagi menguruskan sisa pejal yang dihasilkan daripada sebuah bandar yang mengandungi kawasan kediaman, pusat perdagangan dan kawasan perindustrian. Buat satu analisis mengenai kebaikan dan keburukan menyediakan stesen pemindahan sisa pejal bagi bandar tersebut.

(7 markah)

(c) Satu komuniti mengandungi 25,000 penduduk menghasilkan sisa pejal pada kadar 2 kg seorang/hari. Sisa pejal tersebut dilupuskan ke tapak pelupusan dan dipadatkan pada berat tentu 1000 kg/m^3. Kirakan kedalaman sisa pejal padat selepas 1 tahun tapak pelupusan tersebut beroperasi. Keluasan tapak pelupusan ialah 10 hektar. Andaikan nisbah isipadu sisa pejal-penutup ialah 4:1.

(6 markah)

S7 (a) Terangkan kesan pencemaran udara berikut kepada kesihatan:

(v) Carbon Monosida (CO)
(vi) Nitrogen Dioksida (NO_2)
(vii) Sulfur Oksida (SO_x)
(viii) MP_{10}

(6 markah)

(b) Terangkan faktor yang menyebabkan penyerakan pencemaran udara.

(4 markah)

(c) Kira kecekapan siklon piawai yang mempunyai ciri-ciri seperti dibawah untuk diameter zarah 10 μm dan ketumpatan 800 kg/m^3:

Diameterr tong Siklon = 0.50
Kadar alir gas = 4.0 m^3/s
Suhu gas = 25°C

(10 markah)

Figure 1 : Standard Cyclone

$L_1 = 2D_2$
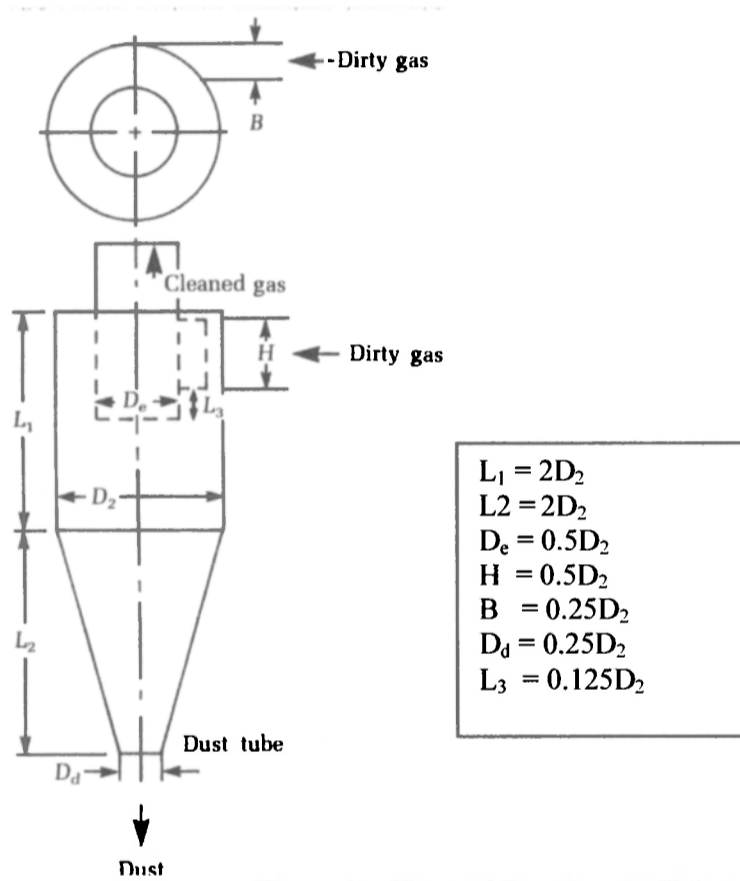$L_2 = 2D_2$
$D_e = 0.5D_2$
$H = 0.5D_2$
$B = 0.25D_2$
$D_d = 0.25D_2$
$L_3 = 0.125D_2$

Figure 2 : Chart of Fractional efficiency

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