

**CONFIDENTIAL**



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2014/2015**

COURSE NAME : ENVIRONMENTAL ENGINEERING  
COURSE CODE : BFC 32403  
PROGRAMME : 3 BFF  
DATE : DECEMBER 2014 / JANUARY 2015  
DURATION : 3 HOURS  
INSTRUCTION : ANSWER FOUR (4) QUESTIONS ONLY

THIS PAPER CONSISTS OF TEN (10) PAGES

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**Answer four (4) questions only.**

- Q1** (a) Define 'environmental engineering' and list the differences between an environmental engineer and environmental scientist. (5 marks)
- (b) Discuss the impacts of air pollution to the environment and quality of living. (5 marks)
- (c) There are various water quality standards which control the quality of raw water as well as wastewater discharges. Name **two (2)** of the relevant standards and explain their functions. (6 marks)
- (d) Discuss **two (2)** most common causes and impacts towards human and environment for each of the environmental phenomenon listed below; (9 marks)
- (i) Greenhouse effect
  - (ii) Acid rain
  - (iii) Climate change

- Q2** (a) Anaerobic decomposition of organic wastes produces acetic acid (CH<sub>3</sub>COOH). Determine the theoretical oxygen demand (ThOD) of 320 mg/L of acetic acid. Assume the following reaction applies;



(4 marks)

- (b) With the aid of a sketch, explain the pattern of oxygen sag curve downstream of a river receiving a constant discharge of biodegradable organic pollutant load at a point upstream. (4 marks)
- (c) A tannery located nearby a stream discharges wastewater at flow rate 0.011 m<sup>3</sup>/s and BOD<sub>5</sub> value of 590 mg/L into the stream. Calculate the ultimate BOD of the tannery if the reaction rate constant  $k = 0.115/\text{d}$ .

A glue factory and wastewater treatment which are also located along the stream discharges wastewater with ultimate BOD shown in **Table Q2(c)**. Calculate the mixed ultimate BOD of the stream after taking into account all discharges from tannery, glue factory and wastewater treatment plat if the stream has flow of 1.7 m<sup>3</sup>/s and ultimate BOD of 0.6 mg/L.

**Table Q2(c)**

Pollutant Sources	Ultimate BOD (mg/L)	Flowrate (m <sup>3</sup> /s)
Glue Factory	255	0.13
Wastewater Treatment Plant	75	0.02

(7 marks)

(d) By using Thomas graphical method and the following data tabulated in **Table Q2(d)**:**Table Q2(d)**

Time (day)	BOD (mg/L)
2	85
5	170
10	235
20	275
35	280

- (i) Plot graph  $\left[ \frac{t}{BOD_t} \right]^{1/3}$  versus time
- (ii) Determine the BOD rate constant,  $k$
- (iii) Determine the ultimate BOD,  $L_0$

(10 marks)

- Q3** (a) Explain the functions of initial water treatment processes which are listed below;
- Water intake
  - Screening
  - Grit removal
  - Aeration

(4 marks)

- (b) Coagulation and flocculation are the most important process in raw water treatment for water supply. Explain the coagulation and flocculation process with respect to;
- Coagulant chemicals used
  - Equations for the chemical reactions

(7 marks)

- (c) In a water treatment plant, two (2) sedimentation tanks were operated in parallel with combined flow of  $0.1 \text{ m}^3/\text{s}$ . If the depth of each tank is 2 m and detention time of 4 hours, calculate the surface area and the overflow rate of each tank.

(8 marks)

- (d) Rapid sand filters of dimensions 10 m x 20 m are used to filter a flow of  $0.8 \text{ m}^3/\text{s}$  at loading rate of  $110 \text{ m}^3/\text{d.m}^2$ . Calculate the number of sand filters needed to accommodate such flow.

(6 marks)

- Q4** (a) Describe the physical, chemical and biological characteristics of a wastewater.

(6 marks)

- (b) Primary treatment of a wastewater is an important process in the whole treatment system of wastewater. Explain **two (2)** main objectives and state **two (2)** benefits of the primary treatment process.

(6 marks)

- (c) A completely mixed activated-sludge plant is used to treat  $12,000 \text{ m}^3/\text{d}$  of municipal wastewater. The wastewater contained  $300 \text{ mg/L}$  of BOD which must be reduced to  $20 \text{ mg/L}$  before discharge to nearby stream. Given mean-cell residence time ( $\theta_c$ ) of 10 days, MLSS ( $X$ ) concentration of  $4,000 \text{ mg/L}$  in the reactor and sludge concentration ( $X_u$ ) of  $12,000 \text{ mg/L}$  in the clarifier, determine ;

- (i) Hydraulic retention time
- (ii) The volume of the reactor
- (iii) The mass and volume of sludge wasted daily

Take value of  $Y = 0.55 \text{ kg/kg}$ , and  $k_d = 0.05 / \text{day}$   
Underflow sludge,  $X_u = 10,000 \text{ mg/L}$

$$\text{Given: } \frac{1}{\theta_c} = \frac{Y(S_o - S)}{\theta X} - k_d \quad \text{and} \quad \theta_c = \frac{VX}{Q_u X_u}$$

(13 marks)

- Q5** (a) Separation and processing of solid waste a very important activity in integrated solid waste management;
- (i) What is meant by solid waste processing/separation and where do these activities take place?
  - (ii) List all components of solid waste that are separated and processed. Describe also the methods and machineries used.
- (6 marks)
- (b) In solid waste management, the concept of 3R (Reduce, Recover and Recycle) is very important to be implemented;
- (i) Describe separately what is meant by the each term Reduce, Recover and Recycle
  - (ii) Suggest how you are going to implement this 3R concept to a town which consists of 50,000 people.
- (6 marks)
- (c) 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.
- (6 marks)
- (d) A community of 300,000 people generates municipal solid waste (MSW) at a rate of 4 kg per person per day. It is compacted in a sanitary landfill to a unit weight of 1000 kg/m<sup>3</sup>. After 1 year of operation, to what depth a 15 hectare compacted MSW will cover?  
Assume an MSW-to-cover ratio is of 4:1.
- (7 marks)

**Soalan dalam Bahasa Melayu. Jawab 4 soalan sahaja.**

- S1** (a) Nyatakan takrif “Kejuruteraan Alam Sekitar” dan senaraikan perbezaan di antara jurutera alam sekitar dan saintis alam sekitar.  
(5 markah)
- (b) Bincangkan kesan pencemaran udara ke atas persekitaran dan kualiti kehidupan.  
(5 markah)
- (c) Dalam pengawalan kualiti air mentah dan air buangan, terdapat beberapa standard yang harus dirujuk. Namakan **dua (2)** standard yang relevan dan nyatakan fungsi-fungsinya.  
(6 markah)
- (d) Bincangkan secara terperinci **dua (2)** punca terjadinya dan juga kesan kepada manusia untuk fenomena-fenomena alam sekitar berikut;  
(i) Kesan rumah kaca  
(ii) Hujan asid  
(iii) Perubahan iklim  
(9 markah)

- S2** (a) Penguraian secara anaerobik sisa organik menghasilkan asid asetik ( $\text{CH}_3\text{COOH}$ ). Kirakan permintaan oksigen secara teori (ThOD) bagi 320 mg/L asid asetik. Anggap tindakbalas berikut berlaku;



(4 markah)

- (b) Dengan bantuan lakaran, terangkan corak lengkung lendutan oksigen ke arah hilir satu sungai yang menerima beban organik terurai secara berterusan pada satu titik di hulu.  
(4 markah)
- (c) Sebuah kilang memproses kulit berdekatan sebatang sungai melepaskan air sisa pada kadar alir  $0.011 \text{ m}^3/\text{s}$  dengan nilai  $\text{BOD}_5$  590 mg/L ke dalam sungai tersebut. Kirakan BOD muktamad air sisa kilang jika konstan kadar tindak balas,  $k = 0.115/\text{d}$ .

Sebuah kilang gam dan loji olahan air sisa juga terletak berhampiran sungai yang sama dan melepaskan air sisa ke dalam sungai pada kadar alir dan BOD muktamad seperti dalam **Jadual S2(c)**. Kirakan BOD muktamad campuran di dalam sungai jika sungai mengalir pada kadar alir  $1.7 \text{ m}^3/\text{s}$  dan nilai BOD muktamad  $0.6 \text{ mg/L}$ .

**Jadual S2(c)**

Sumber Pencemaran	BOD Muktamad $L_0$ , (mg/L)	Kadar alir ( $m^3/s$ )
Kilang gam	255	0.13
Loji olahan air sisa	75	0.02

(7 markah)

- (d) Dengan menggunakan kaedah grafik Thomas dan data yang terdapat dalam **Jadual S2(d)**:

**Jadual S2d**

Masa (hari)	BOD (mg/L)
2	85
5	170
10	235
20	275
35	280

- (i) Plotkan graf  $\left[ \frac{t}{BOD_t} \right]^{1/3}$  melawan masa  
(ii) Kirakan kadar konstan BOD,  $k$   
(iii) Kirakan BOD muktamad,  $L_0$

(10 markah)

- S3** (a) Terangkan fungsi proses-proses awal rawatan air bekalan seperti yang tersenarai;  
(i) Pengambilan air  
(ii) Skrin  
(iii) Pembuangan grit  
(iv) Pengudaraan

(4 markah)

- (b) Koagulasi dan flokulasi adalah proses-proses yang paling penting di dalam proses rawatan air bekalan. Terangkan proses-proses koagulasi dan flokulasi dengan merujuk kepada:

- (i) Kimia koagulan yang digunakan  
(ii) Persamaan tindakbalas yang berlaku

(7 markah)

- (c) Di sebuah loji rawatan air bekalan, terdapat dua (2) tangki pengenapan yang beroperasi secara siri dengan kadar alir gabung  $0.1 \text{ m}^3/\text{s}$ . Jika kedalaman air di dalam setiap tangki adalah 2 m dan masa tahanan 4 jam, kirakan keluasan permukaan tangki dan kadar alir limbah bagi setiap tangki.

(8 markah)

- (d) Beberapa buah penapis pasir cepat berdimensi  $10 \text{ m} \times 20 \text{ m}$  digunakan untuk menapis air pada kadar alir  $0.8 \text{ m}^3/\text{s}$  dengan kadar beban  $110 \text{ m}^3/\text{d.m}^2$ . Kirakan bilangan penapis pasir cepat yang diperlukan untuk menampung kadar alir tersebut.

(6 markah)

- S4** (a) Huraikan sifat-sifat fizikal, kimia dan biologi air sisa.

(6 markah)

- (b) Rawatan prima air sisa adalah salah satu proses yang penting dalam sistem rawatan keseluruhan air sisa. Terangkan dengan jelas **dua (2)** objektif utama rawatan prima dan nyatakan **dua (2)** kelebihan.

(6 markah)

- (c) Satu loji enapcemar teraktif digunakan untuk merawat  $12,000 \text{ m}^3/\text{hari}$  air sisa bandaran. Air sisa tersebut mengandungi  $300 \text{ mg/L}$  BOD yang perlu dikurangkan kepada nilai  $20 \text{ mg/L}$  sebelum boleh dialirkan ke sungai berdekatan. Jika masa tahanan sel ( $\theta_c$ ) ialah 10 hari, kepekatan MLSS ( $X$ ) dalam reactor ialah  $4,000 \text{ mg/L}$  dan kepekatan enapcemar ( $X_u$ ) dalam tangki penjernihan ialah  $12,000 \text{ mg/L}$ , kirakan;

- (i) Isipadu reaktor,  $V$   
 (ii) Masa tahanan hidraulik,  $\theta$   
 (iii) Jisim dan isipadu enapcemar dikeluarkan per hari

Diberi,  $Y = 0.55 \text{ kg/kg}$ ,  $k_d = 0.05 / \text{day}$ ,  
 Aliran bawah enapcemar,  $X_u = 10,000 \text{ mg/L}$

$$\frac{1}{\theta_c} = \frac{Y(S_o - S)}{\theta X} - k_d \quad \text{dan} \quad \theta_c = \frac{VX}{Q_u X_u}$$

(13 markah)



- S5 (a) Pengasingan dan pemprosesan sisa pejal adalah penting dalam pengurusan sisa pejal.
- (i) Apakah yang dimaksudkan dengan pemprosesan / pengasingan sisa pejal dan dimanakah aktiviti ini dijalankan?
  - (ii) Senaraikan semua komponen sisa pejal perbandaran yang diasingkan dan diproses. Huraikan juga kaedah dan jentera yang digunakan. (6 markah)
- (b) Di dalam pengurusan sisa pejal, konsep *3R (Reduce, Recover dan Recycle)* adalah sangat penting untuk diimplementasi;
- (i) Huraikan secara berasingan apakah yang dimaksudkan dengan setiap terma *Reduce, Recover dan Recycle*.
  - (ii) Cadangkan bagaimana cara anda melaksanakan konsep 3R ini untuk sebuah bandar yang mempunyai penduduk 50,000 orang. (6 markah)
- (c) Satu stesen pemindahan sisa pejal dicadangkan dibina untuk sebuah bandar yang mengandungi beberapa taman perumahan, satu pusat komersial dan satu zon industri bagi menguruskan sisa pejal. Lakukan satu analisis berkaitan dengan kebaikan dan keburukan membina satu stesen pemindahan sisa pejal untuk bandar tersebut. (6 markah)
- (d) Satu bandar dengan 300,000 penduduk menjana sisa pejal pada kadar 4 kg per orang per hari. Sisa pejal dilupuskan di tapak timbus tanah sanitari dan dimampat kepada berat unit  $1000 \text{ kg/m}^3$ . Selepas 1 tahun operasi, berapakah kedalaman lapisan sampah jika keluasan sampah yang telah dimampat ialah 15 hektar. Andaikan nisbah sisa pejal perbandaran : tanah penutup ialah 4:1. (7 markah)

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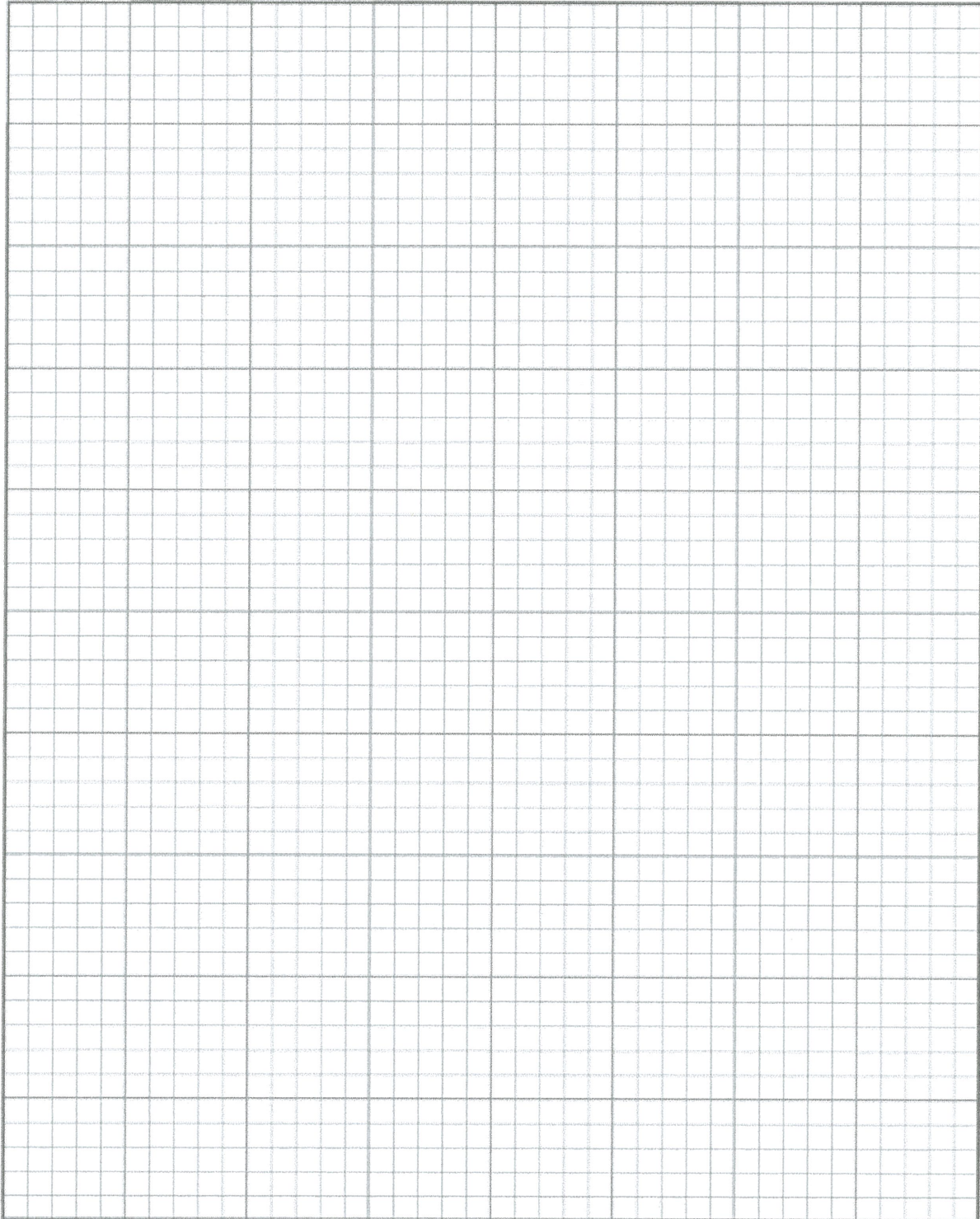
**PEPERIKSAAN AKHIR**

SEMESTER/SESI: SEM 1 SESI 2014/2015

PROGRAM : 3BFT

NAMA KURSUS : KEJURUTERAAN ALAM SEKITAR

KOD KURSUS : BFC32403



(Graph paper for Q2(d) / S2(d)) Name: \_\_\_\_\_ Matric No: \_\_\_\_\_  
(To be submitted with answer book)