



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2009/2010**

SUBJECT NAME : DESIGN OF WASTEWATER  
ENGINEERING

SUBJECT CODE : BFA 4043

COURSE : 4BFF

EXAMINATION DATE : APRIL 2010

DURATION : 3 HOURS

INSTRUCTION : ANSWER FIVE (5) QUESTIONS  
ONLY

**THIS PAPER CONSIST OF SEVEN (7) PAGES ONLY**

- Q1**
- (a) Explain the criteria for siting a new wastewater treatment plant.  
(6 marks)
  - (b) Explain the following design parameters for a sewerage system:
    - (i) Organic Loading
    - (ii) Average Design Dairly flow
    - (iii) Peak Flow Factor(6 marks)
  - (c) Explain the factors that should be considered for the design of a sewer.  
(8 marks)
- Q2**
- (a) Explain the purpose of an equalization tank for a wastewater treatment plant.  
(4 marks)
  - (b) Discuss the factors that should be considered in the design of a pump house.  
(6 marks)
  - (c) A screen chamber is proposed to treat a maximum flow of  $0.15 \text{ m}^3/\text{s}$  of domestic wastewater. Determine the flow through velocity and number of bars required and sketch the chamber to show the dimensions and position of the bars.  
  
*Given :*
    - Length of channel = 2 m
    - Width of channel = 0.6 m
    - Depth of channel = 0.4 m
    - Free board = 0.3 m
    - Bar size = 10 mm x 50 mm
    - Bar spacing = 25 mm(10 marks)

- Q3** (a) Explain the following types of grit chamber for wastewater treatment.
- (i) Rectangular horizontal flow
  - (ii) Detritus tank
  - (iii) Aerated grit chamber
  - (iv) Vortex flow
- (8 marks)
- (b) 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  
 Air supply rate =  $0.3 \text{ m}^3/\text{min.m}$  (length of chamber)  
 Grit settling =  $0.15 \text{ m}^3$  of grit per  $1000 \text{ m}^3$
- (12 marks)
- Q4** (a) Discuss the differences between suspended growth and attached growth in biological wastewater treatment..
- (4 marks)
- (b) Explain the concept of extended aeration in wastewater treatment.
- (6 marks)
- (c) An extended aeration system has been proposed to treat a wastewater flow of  $500 \text{ m}^3/\text{d}$ , with soluble BOD of  $150 \text{ mg/l}$ . Determine the concentration of soluble substrate and the volume of aeration tank.  
 (Given: MLSS =  $4000 \text{ mg/l}$ ,  $Y_t = 0.4$ ,  $K_d = 0.03 \text{ d}^{-1}$ ,  $K = 0.1 \text{ mg/l}$ )
- (10 marks)
- Q5** (a) Explain the removal mechanism for anaerobic biological system.
- (8 marks)
- (b) With diagram, describe the following attach growth anaerobic reactor.
- (i) Packed Bed Reactor (PBR)
  - (ii) Up-flow Anaerobic Sludge Blanket Reactor (UASB)
- (4 marks)
- (c) Propose and discuss a disinfection method for the final stage of a wastewater treatment plant.
- (8 marks)

- Q6** (a) Explain the methods normally used to process sludge before disposal.  
(5 marks)
- (b) Discuss the concept and design consideration for anaerobic stabilisation of sludge.  
(5 marks)
- (c) The sludge produced at a WWTP is 1000 kg/d (on dry solids basis) and has the following characteristics:

Volatile matter of solids	=	70%
S.G of solids	=	102
Mineral matter of solids	=	30%
S.G of mineral matter	=	2.5

Determine the volume of raw and digested sludge assuming reduction in volatile solid is 55% during digestion and moisture content of digested sludge is 92%.

(10 marks)

- S1** (a) Terangkan kriteria pemilihan tapak baru untuk membina logi olahan air sisa.  
(6 markah)
- (b) Terangkan parameter rekabentuk berikut bagi sistem pemptungan:
- (i) Beban Organik
  - (ii) Aliran Rekabentuk Harian Purata
  - (iii) Faktor Aliran Puncak
- (6 markah)
- (c) Terangkan faktor-faktor yang perlu dipertimbangkan untuk rekabentuk pemptung.  
(8 markah)
- S2** (a) Terangkan tujuan tangki penyamaan dalam sistem olahan air sisa.  
(4 marks)
- (b) Bincangkan faktor-faktor yang perlu dipertimbangkan dalam mereka bentuk rumah pum.  
(6 markah)
- (c) Kebuk penapis yang dicadangkan untuk menapis air sisa kumbahan dengan aliran maksimum  $0.15 \text{ m}^3/\text{s}$ . Tentukan aliran masuk melalui kebuk penapis dan juga bilangan bar keluli kebuk penapis yang diperlukan dan lakarkan kebuk penapis dengan menunjukkan dimensi dan kedudukan bar.
- Diberi :*
- Panjang Saluran = 2 m
  - Lebar Saluran = 0.6 m
  - Dalaman Saluran = 0.4 m
  - Ruang Bebas = 0.3 m
  - Saiz bar keluli = 10 mm x 50 mm
  - Jarak antara bar keluli = 25 mm
- (10 markah)

- S3** (a) Terangkan jenis kebuk grit untuk olahan air sisa berikut:
- (i) Aliran ufuk empat segi tepat
  - (ii) Tangki Detritus
  - (iii) Kebuk grit pengudaraan
  - (iv) Aliran Vorteks
- (8 markah)
- (b) Kebuk grit pengudaraan dicadangkan untuk sistem logi olahan air sisa dengan jangkaan aliran purata air domestik 10 MLD. Tentukan dimensi kebuk grit, keperluan udara, and kuantiti grit yang disingkirkan.
- Diberi:*
- |                        |  |
|------------------------|--|
| Faktor Aliran Puncak   | = 2.5  |
| Bilangan Kebuk         | = 2 units  |
| Dalaman Kebuk          | = 2 m  |
| Nisbah Lebar-Kedalaman | = 1.5  |
| Kadar bekalan Udara    | = 0.3 m <sup>3</sup> /min.m (Panjang Kebuk)        |
| Enapan Grit            | = 0.15 m <sup>3</sup> grit per 1000 m <sup>3</sup> |
- (12 markah)
- S4** (a) Bincangkan perbezaan antara *suspended growth* dan *attached growth* dalam proses biologi.
- (4 markah)
- (b) Terangkan konsep sistem *extended aeration* untuk proses olahan air sisa.
- (6 markah)
- (c) Satu sistem *extended aeration* dicadangkan untuk olahan air sisa dengan aliran 500 m<sup>3</sup>/d dan BOD terlarut 150 mg/l. Tentukan kepekatan substrat terlarut and isipadu tangki pengudaraan.  
(Diberi: MLSS = 4000 mg/l,  $Y_t = 0.4$ ,  $K_d = 0.03 \text{ d}^{-1}$ ,  $K = 0.1 \text{ mg/l}$ )
- (10 markah)
- S5** (a) Terangkan mekanisma penyingkiran untuk sistem biologi anaerobik.
- (8 markah)
- (b) Dengan bantuan lakaran gambarajah, diskripiikan reaktor anaerobik 'attach growth' berikut;
- (i) Reaktor *Packed Bed* (PBR)
  - (ii) Reaktor *Up-flow Anaerobic Sludge Blanket* (UASB)
- (4 markah)
- (c) Cadangkan dan bincangkan kaedah nyah-kuman bagi peringkat akhir proses olahan air sisa.
- (8 markah)

- S6 (a) Terangkan kaedah biasa yang digunakan untuk proses enap cemar sebelum ia dilupuskan. (5 markah)
- (b) Bincangkan konsep dan pertimbangan rekabentuk untuk penstabilan enap cemar anaerobik. (5 markah)
- (c) Penghasilan enap cemar di logi olahan air sisa ialah 100kg/d (berdasarkan kepada pepejal kering) dan mempunyai ciri-cir berikut:

Bahan meruap pepejal	=	70 %
S.G. pepejal	=	1.02
Bahan mineral pepejal	=	30 %
S.G. bahan mineral	=	2.5

Tentukan isipadu enap cemar yang belum terurai dan yang telah terurai andaian pengurangan pepejal meruap ialah 55% semasa penguraian dan kandungan lembapan enap cemar terurai ialah 92%.

(10 markah)