UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2010/2011

COURSE NAME	: DESIGN OF WASTEWATER ENGINEERING
COURSE CODE	: BFA 4043
PROGRAMME	: 4BFF
DATE	: NOVEMBER/ DECEMBER 2010
DURATION	: 3 HOURS
INSTRUCTION	: ANSWER FIVE (5) QUESTIONS ONLY

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

Q1 (a) State the significant physical, chemical and biological parameters to characterize wastewater.

(6 marks)

(b) Discuss the design criteria used to calculate the reactor volume and to evaluate the performance of biological processes.

(8 marks)

(c) A diameter of clarifier is 1.8 m and an average wastewater flow rate is 40.0 MLD. Calculate the hydraulic detention time and surface loading rate of a clarifier having a wastewater depth of 2.5 m in the clarifier.

(6 marks)

Q2 (a) Explain the purpose of equalization tank for wastewater treatment system.

(4 marks)

(b) Discuss the factors that are considered in the design of a pump house.

(6 marks)

(c) A screen chamber is proposed to treat a maximum flow of 0.15 m^3/s of domestic wastewater. Determine the flow through velocity and numbers of bars. Then sketch the diagram of the screen chamber to show the dimensions, position of bars and spacing between 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
Provide bar size = 10 mm x 50 mm
Bar spacing = 25 mm

(10 marks)

Q3 (a) Explain the factors that will be considered to design a sewerage system.

(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 : 1
An air supply rate = 0.3 m^3/min.m (length of chamber)
Grit settling = 0.15m^3 of grit per 1000m^3

(12 marks)

Q4 (a) Define the following bio-kinetic constants for aerobic biological processes:

(i) Specific Growth rate, μ
(ii) Yield Coefficient, Y
(iii) Maximum Substrate Utilization Rate Constant, K
(iv) Endogenous Decay Coefficient, K_d

(10 marks)

(b) An extended aeration system has been proposed to treat a wastewater flow of 500 m^3/d, with soluble BOD of 150 mg/l. Determine the concentration of soluble substate and the volume of aeration tank.
(Given: MLSS = 4000 mg/l, Yt = 0.4, Kd = 0.03 d^{-1}, K =0.1 mg/l)

(10 maks)

Q5 (a) Discuss briefly the design concepts of anaerobic biological treatment processes.

(8 marks)

(b) Determine the size of Up-Flow Anaerobic Sludge Blunket (UASB) reactor, hydraulic retention time and MLSS in the sludge zone of the reactor that can remove 85% COD from 2 MLD flow of wastewater. Assuming the following data:

Soluble influent COD	=	1000 mg/L
Up-flow velocity	=	2.0 m/h
Organic loading rate	=	12 kg soluble BOB/m^3.d
Solids retention time	=	15 d
Volume effective factor	=	0.85

(12 marks)

Q6 (a) Describe the normal methods used to process the sludge before its final disposal.

(6 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) Final stage of wastewater treatment is disinfection process, propose a method of disinfection and then explain its process.

(8 marks)

S1 (a) Nyatakan parameter fizikal, kimia dan biologi yang utama untuk mencirikan air sisa.

(6 markah)

(b) Bincangkan kriteria rekabentuk yang digunakan untuk mengira isipadu reaktor dan menilai prestasi proses biologi.

(8 markah)

(c) Diameter tangki enap cemar ialah 1.8 m dan kadar alir purata air sisa adalah 40.0 MLD. Kira masa tahan (HRT) dan kadar beban permukaan untuk tangki enap cemar yang mempunyai kedalaman air sisa 2.5 m.

(6 markah)

S2 (a) Terangkan tujuan tangki penyamaan dalam system olahan air sisa.

(4 markah)

(b) Bincangkan faktor-faktor yang dipertimbangkan dalam rekabentuk rumah pam.

(6 markah)

(c) Kebuk penapis yang dicadangkan untuk menapis air sisa kumbahan dengan aliran maksimum 0.15 m^3/s. Tentukan aliran masuk melalui kebuk penapis dan juga bilangan bar keluli kebuk penapis. Lakarkan rajah kebuk penapis dengan menunjukkan dimensi, kedudukan bar keluli dan juga jarak antara bar keluli.

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)

Q3 (a) Terangkan faktor-faktor yang perlu dipertimbangkan untuk rekabentuk sistem pembetungan.

(8 markah)

(b) Kebuk grit pengudaraan yang dicadangkan untuk sistem logi olahan air sisa dengan jangkaan aliran purata kumbahan domestik sebanyak 10 MLD. Tentukan dimensi kebuk grit, keperluan udara dan kuantiti grit yang disingkirkan.

Diberi:

Faktor Aliran Puncak	= 2.5
Bilangan Kebuk	= 2 units
Dalaman Kebuk	= 2 m
Nisbah Lebar-Kedalaman	= 1.5 : 1
Kadar bekalan Udara	= 0.3 m^3/min.m (Panjang Kebuk)
Enapan Grit	= 0.15m^3 grit per 1000m^3

(12 markah)

Q4 (a) Takrifkan pekali bio-kinetik bagi proses biologi aerobik yang berikut:

(i) Kadar tumbuhan spesifik, μ
(ii) Pekali pembiakan, Y
(iii) Pekali kadar penggunaan substrat maksimum, K
(iv) Pekali kematian endogenus, Kd

(10 markah)

(b) Satu sistem 'extended aeration' telah dicadangkan untuk olahan air sisa dengan aliran 500 m^3/d dan BOD terlarut 150 mg/l. Tentukan kepekatan substrat terlarut and isipadu tangki pengudaraan.
(Diberi: MLSS = 4000 mg/l, Yt = 0.4, Kd = 0.03 d^{-1}, K =0.1 mg/l)

(10 markah)

Q5 (a) Bincangkan konsep rekabentuk proses olahan biologi anaerobik.

(8 markah)

(b) Tentukan saiz reaktor 'Up-Flow Anaerobic Sludge Blunket', masa tahanan dan MLSS di dalam zon enap cemar untuk reaktor tersebut yang boleh menyingkir 85% COD dengan aliran air sisa 2 MLD. Diandaikan data adalah seperti berikut:

Influen COD terlarut	=	1000 mg/L
Halaju aliran menaik	=	2.0 m/h
Kadar beban organik	=	12 kg BOD terlarut/m^3.d
Umur enap cemar (SRT)	=	15 d
Faktor berkesan isipadu	=	0.85

(12 markah)

Q6 (a) Huraikan kaedah lazim yang digunakan untuk memproses enap cemar sebelum pelupusan akhir.

(markah)

(c) Penguraian enap cemar secara anaerobik merupakan salah satu kaedah yang digunakan secara meluas untuk mengurai dan menstabilkan bahan kandungan organik dan bukan organik di dalam enap cemar. Bincangkan secara ringkas proses penguraian yang berlaku di dalam sistem di peringkat hidrolisis, asidogenesis and metanogenesis.

(5 markah)

(d) Peringkat akhir olahan sisa adalah proses nyah-kuman, cadangkan satu kaedah nyah-kuman dan terangkan proses nyah-kuman tersebut.

(5 marks)