



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012**

COURSE NAME : WATER SUPPLY DESIGN
COURSE CODE : BFA 4023
PROGRAMME : BFF
EXAMINATION DATE : JUNE 2012
DURATION : 3 HOURS
INSTRUCTION : ANSWER QUESTION 1 AND
THREE (3) OTHER QUESTIONS

THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

Q1 A pumped storage type of water supply scheme is proposed for a community. The design data available are as follows:

- Population = 20,000 people
- Domestic demand=320 LPCD
- Other water demands = 110% of domestic demand
- Fire fighting = 350 m³/h for 6h duration
- Effective lift for low lift pumping = 30m
- Effective lift for high lift pumping = 80m
- Pumping of treated water = 8h daily
- Length of pipe from intake to WTP = 1000m
- Length of pipe from WTP to an uphill reservoir = 1500m

Determine the following:

- (i) The size of the pipe from the intake to the WTP
- (ii) The size of the pipe from the WTP to the uphill reservoir
- (iii) The amount of water required for fire fighting
- (iv) The total amount of storage for the community
- (v) The power of the low lift pump assuming the overall efficiency is 65%
- (vi) The power of the high lift pump assuming the overall efficiency is 65%

State any assumptions made. Use the Hazen-Williams nomograph (Figure 1) to estimate the friction loss in pipe.

(25 marks)

Q2 (a) Explain the conditions for which pre-sedimentation is required prior to chemical coagulation at a water treatment plant.

(5 marks)

(b) A number of two (2) similar rectangular pre-sedimentation basins are required to settle out heavy solids from muddy river water prior to chemical coagulation at a water treatment plant. Based on an average flow of 6720 m³/d determine the length and width one basin for a specified detention time of 3 h and depth of the basin 2.5m.

(20 marks)

Q3 (a) Sketch the movement of water and solids in a rectangular sedimentation tank for water treatment.

(5 marks)

(b) Sketch the movement of water and solids in a circular sedimentation tank for water treatment.

(5 marks)

- (c) Two (2) similar rectangular sedimentation basins are required following chemical flocculation at a water treatment plant. If the average flow is $6720 \text{ m}^3/\text{d}$, determine the length (L) and width (W) of one basin to satisfy the following at the average flow conditions:

Detention time = 3 h
 Basin depth $D = 2.5 \text{ m}$
 Maximum weir loading = $250 \text{ m}^3/\text{d}/\text{m}$
 Surface overflow rate = $20 \text{ m}^3/\text{d}/\text{m}^2$
 Maximum horizontal velocity = $2.5 \text{ mm}/\text{s}$

(15 marks)

- Q4** (a) For a design flow of $6720 \text{ m}^3/\text{d}$, a circular tray type aerator is proposed for a water treatment plant. Determine the number of trays required for a specified requirement of 1.0 m^2 of exposed water surface for every $0.3 \text{ m}^3/\text{min}$ of design flow. Assume the top tray is 2.0 m in diameter and the trays below each have 30% more surface area successively till the last tray.

(10 marks)

- (b) Two (2) similar rectangular paddle flocculation tanks are required at a water treatment plant to satisfy the following conditions:

Design flow = $6720 \text{ m}^3/\text{d}$
 Velocity gradient, G in the tank = 25 per second
 Detention time, $t = 20 \text{ min}$
 Depth of the tank, $D = 2.8 \text{ m}$
 Width of the tank, $W = 3.5 \text{ m}$
 Dynamic viscosity of water, $\mu = 0.0008 \text{ N}\cdot\text{s}/\text{m}^2$.

For each tank determine the following:

- (i) The length (L) of the basin
- (ii) The power (kW) to drive the paddle flocculator
- (iii) The width of the paddle (mm), assuming there are four (4) paddles, each 2.0 m long, on the horizontal shaft and the area of the three paddles (both sides) should be 10% of the cross-sectional area (W times D) of the tank.

(15 marks)

- Q5**
- (a) Sketch the cross-section of typical granular-media gravity filter and name all its important features. (5 marks)
 - (b) Explain the requirements to provide direct filtration for treating raw river water in terms of reduction of turbidity and colour. (5 marks)
 - (c) Determine the number of similar filters required following sedimentation for a design flow of 25 MLD at a water treatment plant. Hence determine the area of filter bed for each filter for a specified application rate of $3.5\text{m}^3/\text{d}/\text{m}^2$. (10 marks)

What would be the filter area of each rapid sand filters had the filters (total 8 numbers) been used instead of the slow sand filters? Assume each rapid filter can accept 50 times the application rate of the slow sand filter.

(5 marks)

- S1** Skim air bekalan dari jenis pam dan simpanan adalah dicadangkan bagi sebuah komuniti. Data rekabentuk adalah seperti berikut:

Populasi = 20,000 orang
 Keperluan domestic = 320 LPCD
 Keperluan air lain = 110% keperluan domestik
 Melawan kebakaran = $350 \text{ m}^3/\text{jam}$ untuk tempoh 6 jam
 Angkut berkesan untuk pengepaman angkut rendah = 30m
 Angkut berkesan untuk pengepaman angkut tinggi = 80m
 Pengepaman air terawat = 8 jam seharian
 Panjang paip dari ambilan ke loji rawatan air = 1000m
 Panjang paip daripada loji rawatan air ke takungan (di puncak) = 1500m

Tentukan yang berikut:

- (i) Saiz paip daripada ambilan ke loji rawatan air.
- (ii) Saiz paip daripada loji rawatan air ke takungan (di puncak)
- (iii) Jumlah air diperlukan untuk melawan kebakaran
- (iv) Jumlah simpanan untuk komuniti
- (v) Kuasa untuk pam angkut rendah, anggapan the kecekapan keseluruhan adalah 65%
- (vi) Kuasa untuk pam angkut tinggi , anggapan kecekapan keseluruhan adalah 65%

Tulis semua andaian yang digunakan. Guna Hazen-Williams nomograph (Rajah 1) to untuk anggarkan kehilangan akibat geseran didalam paip

(25 markah)

- S2** (a) Terangkan keadaan dimana pra- penganapan diperlukan terutamanya jika ada penggumpalan kimia di loji rawatan air.

(5 markah)

- (b) Dua (2) unit takungan pra penganapan segi empat tepat seragam diperlukan untuk mengenakan pepejal berat dari sebuah sungai berlumpur terutamanya jika ada penggumpalan kimia di loji rawatan air. Berdasarkan purata kadar alir $6720 \text{ m}^3/\text{hari}$, tentukan panjang dan lebar satu takungan untuk masa tahanan 3 jam dan kedalaman takungan 2.5m.

(20 markah)

- S3** (a) Lakarkan pergerakan air dan pepejal dalam takungan penenapan segiempat tepat di loji rawatan air.

(5 markah)

- (b) Lakarkan pergerakan air dan pepejal dalam takungan penenapan bulat di loji rawatan air.

(5 markah)

- (c) Dua (2) takungan penenapan segi empat tepat seragam diperlukan bagi pengentalan kimia di loji rawatan air. Jika purata kadar alir adalah $6720 \text{ m}^3/\text{hari}$, tentukan panjang (L) dan lebar (W) bagi satu takungan yang memenuhi kriteria berikut pada keadaan aliran purata:

Masa tahanan = 3 jam

Kedalaman takungan, $D = 2.5 \text{ m}$

Beban alir limbah maksima = $250 \text{ m}^3/\text{hari}/\text{m}$

Kadar alir limbah permukaan = $20 \text{ m}^3/\text{hari}/\text{m}^2$

Halaju ufuk maksima = $2.5 \text{ mm}/\text{saat}$

(15 markah)

- S4 (a) Sebuah pengudara dulang bulat dicadangkan bagi kadaralir rekabentuk $6720\text{m}^3/\text{hari}$, di sebuah loji rawatan air. Tentukan jumlah dulang yang diperlukan dengan ketetapan bagi setiap 1.0 m^2 permukaan air terdedah memerlukan $0.3\text{m}^3/\text{minit}$ daripada aliran rekabentuk. Anggap dulang teratas adalah 2.0m diameter dan dulang dibawah bertambah setiap satunya luas permukaan air sebanyak 30% hingga ke dulang terakhir.

(10 markah)

- (c) Dua (2) tangki pengentalan berdayung segi empat tepat seragam diperlukan di loji rawatan air untuk memenuhi kriteria berikut:

Kadaralir rekabentuk = $6720\text{ m}^3/\text{hari}$
 Kecerunan halaju, G dalam tangki = 25 per saat
 Masa tahanan, $t = 20$ min
 Kedalaman tangki, $D = 2.8$ m
 Kelebaran tangki, $W = 3.5$ m
 Kelikatan dinamik air, $\mu = 0.0008\text{ N}\cdot\text{s}/\text{m}^2$.

Bagi setiap tangki tentukan yang berikut:

- (i) Panjang takungan
- (ii) Kuasa (kW) diperlukan untuk memutar dayung pengentalan.
- (iii) Lebar dayung (mm), anggap ada empat (4) dayung setiap set, setiap satu 2.0m panjang, terletak di ufuk aci dan luas tiga set dayung (kedua-dua sisi) adalah 10% daripada luas keratan rentas ($W \times D$) tangki.

(15 markah)

Q5 (a) Lakarkan keratan rentas sebuah penuras- media berbutir tipikal dan namakan semua komponen yang utama. (5 markah)

(b) Terangkan keperluan menyediakan penuras langsung untuk merawat air sungai bagi keperluan penyingkiran kekeruhan dan warna. (5 markah)

(c) Tentukan bilangan penuras seragam yang diperlukan selepas tangki pegenapan bagi kadar alir rekabentuk 25 MLD di loji rawatan air. Oleh itu, tentukan luas penuras untuk setiap penuras dengan kadar limpah permukaan $3.5\text{m}^3/\text{hari}/\text{m}^2$. (10 markah)

Apakah luas penuras untuk setiap penuras pasir cepat yang mempunyai penuras (bilangan 8) berbanding penuras pasir perlahan? Anggap setiap penuras cepat boleh menerima 50 kali ganda kadar limpah permukaan penapis perlahan.

(5 markah)

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