UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2015/2016 Academic Session

June 2016

EAP215 – Water Supply and Water Treatment Engineering
[Kejuruteraan Bekalan dan Olahan Air]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **TEN (10)** pages of printed material including **ONE (1)** appendix before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEPULUH (10)** muka surat yang bercetak termasuk **SATU (1)** lampiran sebelum anda memulakan peperiksaan ini.]*

Instructions : This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions.

*[**Arahan** : Kertas ini mengandungi **ENAM (6)** soalan. Jawab **LIMA (5)** soalan.]*

All questions **MUST BE** answered on a new page.

*[Semua soalan **MESTILAH** dijawab pada muka surat baru.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]

1. [a] Surface water is a major source for drinking water. Categorize and elaborate **FIVE (5)** sources of pollution in surface water.

*Air permukaan adalah punca utama air minuman. Kategori dan terangkan **LIMA (5)** punca pencemaran air permukaan.*

[5 marks/markah]

[b] Total Suspended Solids (TSS) is one of the physical characteristics of water quality. Describe **THREE (3)** sources and **THREE (3)** impacts of TSS in the river system.

*Jumlah Pepejal Terampai (TSS) merupakan salah satu ciri fizikal kualiti air. Terangkan **TIGA (3)** sumber dan **TIGA (3)** impak TSS terhadap sistem sungai.*

[5 marks/*markah*]

[c] Briefly describe the following terms with respect to water supply and treatment engineering:

Terangkan secara ringkas terma-terma berikut dalam konteks kejuruteraan bekalan dan olahan air:

[i] Intake facilities
Kemudahan pengambilan

[ii] Infiltration
Penyusupan

[iii] Groundwater
Air bumi

[6 marks/*markah*]

[d] Water intake facilities are important components in water supply system. In proper sequence, please provide **FOUR (4)** components in the water supply intake facilities.

*Kemudahan pengambilan air merupakan komponen penting dalam sistem bekalan air. Dengan susunan yang betul, sila terangkan **EMPAT (4)** komponen yang terdapat dalam kemudahan pengambilan air.*

[4 marks/*markah*]

2. Total planning of water demand for developing areas is essential to serve various purposes and is expected to increase extensively in Peninsular Malaysia.

Keseluruhan perancangan permintaan air bagi kawasan-kawasan membangun adalah penting bagi tujuan pembekalan untuk pelbagai tujuan dan ia dianggarkan akan meningkat secara signifikan di Semenanjung Malaysia.

[a] List **THREE (3**) types of demand that exist in these developing urban areas.

*Senaraikan **TIGA (3)** jenis permintaan yang wujud dalam pembangunan kawasan bandar.*

[3 marks/*markah*]

[b] Describe **FOUR (4)** factors that will influence water demand.

*Terangkan **EMPAT (4)** faktor yang mempengaruhi permintaan air.*

[4 marks/*markah*]

[c] Explain **THREE (3)** reasons that could lead to inaccuracy in meter reading.

*Terangkan **TIGA (3)** sebab yang boleh menyebabkan pembacaan meter yang tidak tepat.*

[3 marks/*markah*]

[d] Predict the population for the years 2031 and 2061 based on **Table 1** by using arithmetic and geometric methods. As a consultant, suggest and justify a suitable method for the prediction for year 2061.

Ramal populasi bagi tahun 2031 *dan* 2061 *berdasarkan **Jadual 1** menggunakan kaedah aritmatik dan geometrik. Sebagai perunding, cadang dan beri justifikasi satu kaedah sesuai untuk membuat ramalan bagi tahun 2061.*

[10 marks/*markah*]

Table 1 / Jadual 1

Year/ *Tahun*	1941	1951	1961	1971	1981	1991	2001	2011
Population:(thousands)/ *Populasi:(ribu)*	60	65	63	72	79	89	97	120

3. [a] With the aid of a sketch diagram, discuss on raw water storage as a potable water pretreatment method in terms of the objectives, suitability and problems encountered.

Dengan bantuan rajah yang dilakar, bincangkan tentang takungan air mentah sebagai kaedah pra-rawatan air minuman berdasarkan objektif, kesesuaian dan masalah yang dihadapi.

[10 marks/*markah*]

[b] A laboratory jar test indicates that 5 mL alum solution which is added with 1000 mL raw water has given an optimum floc. Alum solution was made based on 10 gram of alum dissolved in 1000 mL of distilled water. Calculate the amount of alum required for one day if the treatment plant operates with a capacity of 5 million litres per day (MLD).

If the treatment plant operates in three shifts for a period of 24 hours, calculate the volume of alum mixing tank that should be provided for one shift if 10% alum solution is prepared.

Ujian balang di makmal menunjukkan 5 mL larutan alum yang dicampur dengan 1000 mL air mentah telah memberikan flok optimum. Larutan alum telah disediakan berdasarkan 10 gram alum dilarutkan dengan 1000 mL air suling. Hitung amaun alum yang diperlukan untuk satu hari jika loji olahan beroperasi dengan kapasiti 5 juta liter sehari (JLH).

Jika loji olahan beroperasi dalam 3 shif untuk tempoh 24 jam, hitung isipadu tangki pencampuran alum yang perlu disediakan untuk satu shif jika 10% larutan alum disediakan.

[10 marks/*markah*]

4. [a] Briefly explain the following terms with respect to potable water treatment:

Terangkan dengan ringkas mengenai terma-terma berikut berdasarkan olahan air minuman:

[i] Coagulation
Pengentalan

[2 marks/*markah*]

[ii] Flocculation
Pemberbukuan

[2 marks/*markah*]

[b] A water treatment plant has a capacity of 2.5 million litres per day (MLD). Flocculation process involves two stages with two tanks constructed in series. Retention times in both tanks are the same at 20 minutes with velocity gradients at $30s^{-1}$ and $20s^{-1}$ for the first and second stages of flocculation, respectively. Calculate the volume and power input in each tank if the dynamic viscosity of the water is $1.145x10^{-3}$ Ns/m^2.

Loji olahan air mempunyai kapasiti 2.5 juta liter sehari (JLH). Proses pemberbukuan melibatkan dua peringkat dengan dua tangki dibina dalam susunan siri. Masa tahanan untuk kedua dua tangki adalah sama iaitu 20 minit dengan kecerunan halaju adalah masing-masing $30s^{-1}$ dan $20s^{-1}$ untuk peringkat pertama dan kedua. Hitung isipadu dan kuasa yang dikenakan pada setiap tangki jika kelikatan dinamik air adalah $1.145x10^{-3}$ Ns/m^2.

[6 marks/*markah*]

[c] A horizontal flow sedimentation tank is designed with a capacity of 1.8 million litres per day (MLD) with length to width ratio of 4:1, surface loading 30 m/day and retention time of 3 hours. Calculate the length, width and depth of the sedimentation tank. If the outlet weir is made up of concrete in the form of a box or rectangular shape that does not touch the downstream wall of the tank, calculate the total length of this weir and sketch your design.

Tangki enapan aliran mendatar direkabentuk dengan kapasiti 1.8 juta liter sehari (JLH) dengan nisbah panjang kepada lebar 4:1, beban permukaan 30 m/hari dan masa tahanan 3 jam. Hitung panjang, lebar dan kedalaman tangki enapan. Jika alur limpah keluar diperbuat daripada konkrit dalam bentuk kekotak atau bentuk segi empat tepat yang tidak menyentuh dinding hiliran tangki, hitung jumlah panjang alur limpah ini dan lakarkan rekabentuk anda.

[10 marks/*markah*]

5. [a] Briefly explain the pre-chlorination in potable water treatment.

Jelaskan dengan ringkas mengenai pra-pengklorinan dalam rawatan air minuman.

[4 marks/*markah*]

[b] Discuss the performance of rapid sand filter for potable water treatment in terms of filtration rate, penetration of suspended solids, method of filter cleaning, and the treatment processes required prior to filtration.

Bincangkan tentang prestasi penuras pasir perlahan untuk olahan air minuman dari segi kadar penurasan, tusukan pepejal terampai, kaedah pencucian dan proses olahan diperlukan sebelum penurasan.

[8 marks/*markah*]

[c] Describe **FOUR (4)** important characteristics of disinfection agent required for potable water treatment.

*Jelaskan **EMPAT (4)** ciri penting bahan pembasmi kuman yang diperlukan untuk rawatan air minuman.*

[8 marks/*markah*]

6. [a] Describe **FIVE (5)** requirements that need to be considered for the design and construction of a water distribution system with respect to water supply engineering.

*Jelaskan **LIMA (5)** keperluan yang perlu dipertimbangkan untuk merekabentuk dan membina sistem agihan air dalam konteks kejuruteraan bekalan air.*

[5 marks/*markah*]

[b] With the aid of a sketch diagram briefly describe gravity water distribution system.

Dengan bantuan rajah yang dilakar, jelaskan dengan ringkas mengenai sistem agihan air graviti.

[5 marks/*markah*]

[c] **Figure 1** shows a reticulation system in a housing estate. Estimate the flow rate in each pipeline using Hardy-Cross Method and Hazen-William formula up-to two iterations. Adopt Hazen-William coefficient C as 100. Use an initial flow rate of 80 litres per second (lps) from point A to B. The parameters for the pipes are as follows:

Pipe AB: length = 1200 m and diameter = 300 mm
Pipe BC: length = 700 m and diameter = 250 mm
Pipe CD: length = 1500 m and diameter = 250 mm
Pipe AD: length = 600 m and diameter = 300 mm

Rajah 1 *menunjukkan sistem retikulasi untuk sebuah kawasan perumahan. Anggarkan kadar alir dalam setiap paip menggunakan Kaedah Hardy-Cross dan rumus Hazen-William dengan pengiraan sehingga dua lelaran. Anggap pekali Hazen-Willian, C sebagai 100. Gunakan kadar alir awal dari titik A ke B sebanyak 80 liter sesaat (lps). Parameter untuk paip seperti berikut:*

Paip AB: panjang = 1200 m dan garispusat = 300 mm
Paip BC: panjang = 700 m dan garispusat = 250 mm
Paip CD: panjang = 1500 m dan garispusat = 250 mm
Paip AD: panjang = 600 m dan garispusat = 300 mm

The following formula may be useful:

Rumus berikut mungkin boleh membantu:

$$H_L = \frac{1128x10^9}{D^{4.87}} L\left(\frac{Q}{C}\right)^{1.85}$$

[10 marks/*markah*]

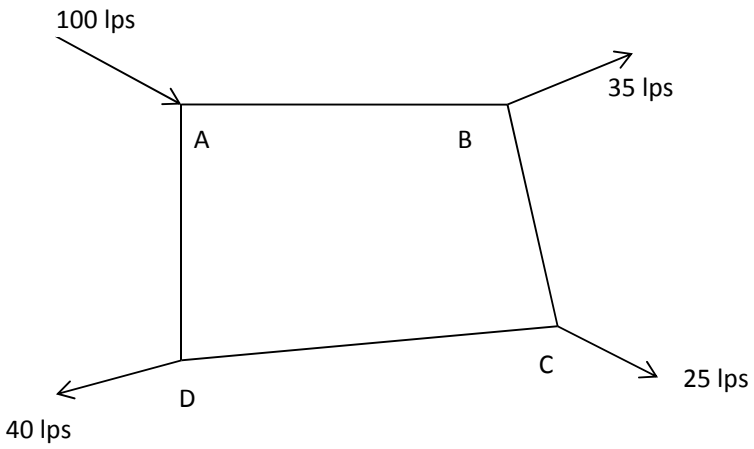

Figure 1 / *Rajah 1*

APPENDIX/*LAMPIRAN*

Equations related to water supply:/*Persamaan berkaitan bekalan air:*

$F=18C(A)^{0.5}$

$P_n = P_i + nI$

$P_n = P_i\left(1+\frac{i}{100}\right)^n$

$P_n = P_i + n(I+m)$

$P_n = P_i\left(1+\frac{(1-k}{100}\right)^n$

$G = \left(\frac{P}{\mu\forall}\right)^{1/2}$

$P = \frac{1}{2}C_d\rho A\vee^3$

$P = \rho Qgh$

$h_L = KQ^2$

$\frac{d_1}{d_2} = \frac{1}{2}\left[\left(1-8F^2\right)^{1/2}-1\right]$

$F = \frac{V_1}{(gd_1)^{1/2}}$

$\mathrm{Re} = \frac{\rho vd}{\mu}$

$\Delta H = [(v_1^2 + 5v_2^2 + 4v_3^2)/2g] + \text{normal channel friction}$

$h = \frac{nv_1^2 + (n-1)v_2^2}{2g}$

$v_s = \frac{gd^2(\rho_s - \rho_w)}{18\mu}$

$t = \frac{2\pi H}{Q}\int_{R1}^{R2} rdr = \frac{\pi\left(R_2^2 - R_1^2\right)H}{Q}$

$V_s = \frac{Q}{A}$

$D = V_s t$

$L = \frac{0.2Q}{HV_s}$

$H = \frac{1128\times10^9}{d^{4.87}}\left[\frac{Q}{100}\right]^{1.85}$

$\Delta = -\frac{\Sigma H}{N\sum\frac{H}{Q_a}}$

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