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UNIVERSITI SAINS MALAYSIA

Second Semester Examination  
Academic Session 2006/2007

April 2007

**EAH 225/3 – Hydraulic**  
**[Hidraulik]**

Duration : 3 hours  
[Masa : 3 jam]

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Please check that this examination paper consists of SEVEN pages of printed material including appendices before you begin the examination.

*[Sila pastikan kertas peperiksaan ini mengandungi TUJUH muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]*

**Instructions:** Answer **FIVE** (5) questions only. All questions carry the same marks.

*[**Arahan:** Jawab **LIMA** (5) soalan sahaja. Semua soalan membawa jumlah markah yang sama.]*

You may answer the question either in Bahasa Malaysia or in English or a combination of both languages.

*[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris ataupun kombinasi kedua-dua bahasa.]*

Write the answered question numbers on the cover sheet of the answer script.

*[Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.]*

1. [a] Describe briefly on pipe losses for the following condition:

- operation in series
- operation in parallel

(4 marks)

1. [a] Terangkan dengan ringkas mengenai kehilangan paip untuk dua keadaan berikut:

- operasi selari dan
- operasi bersiri

1. [b] State the concept in minor losses and give **THREE (3)** examples.

(4 marks)

1. [b] Terangkan konsep kehilangan minor dan berikan **TIGA (3)** contoh.

1. [c] Determine total head required by the pump to transfer water from Tank 1 to Tank 2 as shown in Figure 1. The characteristics of the system are:

Pipe diameter	= 0.15 m
Pipe length	= 180 m
Pipe roughness	= 0.025 mm
Flow from Tank 1 to Tank 2, Q	= 62.5 L/s
Kinematic viscosity, $\nu$	= $1.0 \times 10^{-6} \text{ m}^2/\text{s}$

(Class 1 system)

$$Re = \frac{\rho V D}{\mu} ; \quad h_t = f \left( \frac{L}{D} \right) \left( \frac{V^2}{2} \right)$$

(12 marks)

1. [c] Tentukan jumlah turus yang diperlukan oleh pam untuk menyalurkan air dari Tangki 1 ke Tangki 2 seperti di Rajah 1 berpandukan ciri paip berikut:

Garispusat	= 0.15 m
Panjang paip	= 180 m
Kekasaran paip	= 0.025 mm
Kadar alir dari Tangki 1 ke Tangki 2, Q	= 62.5 L/s
Kelikatan kinematik cecair, $\nu$	= $1.0 \times 10^{-6} \text{ m}^2/\text{s}$

(Class 1 system)

$$Re = \frac{\rho V D}{\mu} ; \quad h_t = f \left( \frac{L}{D} \right) \left( \frac{V^2}{2} \right)$$

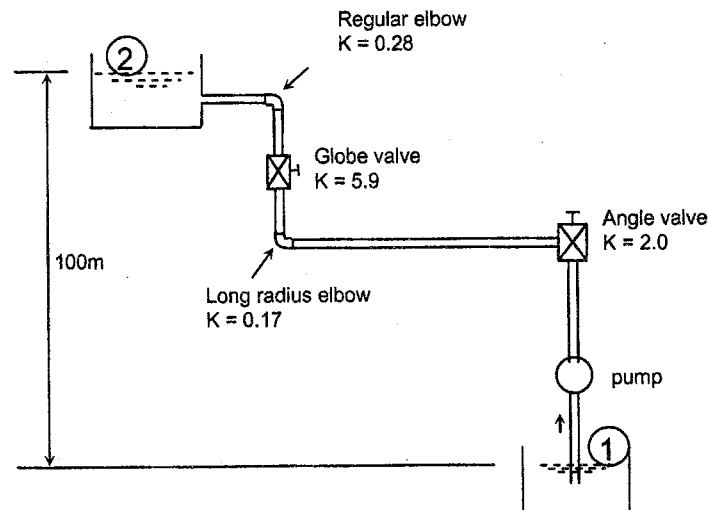


Figure 1 (Rajah 1)

2. [a] Discuss the relationship of fluid flow, pipe and towards friction factor in the Moody Diagram. (6 marks)
2. [a] Bincangkan perhubungan antara jenis aliran, jenis paip dan jenis cecair dengan faktor geseran dalam Carta Moody.
2. [b] Water flows from Tank A to Tank B through 1 km cast iron pipe. The first 500 m has 12 cm diameter and the rest is 6 cm. The head different between these two tanks is 30 m. With the help of sketch drawing, determine discharge through the pipe system if the friction factor is 0.005 for both pipe.

(Class 2 system)

$$Re = \frac{\rho VD}{\mu} : \quad h_f = f \left( \frac{L}{D} \right) \left( \frac{V^2}{2} \right)$$

(14 marks)

2. [b] Air mengalir dari Tangki A ke Tangki B yang disambungkan oleh sebatang paip besi tetuang (cast iron) sepanjang 1 km. Pada separuh jarak pertama, paip bergaris pusat 12 cm dan selebihnya 6 cm. Tinggi perbezaan turus antara dua tangki tersebut adalah 30 m. Dengan bantuan lakaran, tentukan kadar alir melalui sistem paip tersebut sekiranya dianggap faktor geseran adalah 0.005 untuk kedua-dua paip tersebut.

(Class 2 system)

$$Re = \frac{\rho VD}{\mu} : \quad h_f = f \left( \frac{L}{D} \right) \left( \frac{V^2}{2} \right)$$

Nota: E untuk besi tetulang 0.20 mm

3. [a] A hydraulic jump is formed in a wide channel having flow discharge of  $2 \text{ m}^3/\text{s}$  at depth of  $0.15 \text{ m}$ . Compute the percentage of energy loss due to the hydraulic jump.

(5 marks)

3. [a] Aliran dalam sebuah saluran lebar dengan unit luahan sebanyak  $2 \text{ m}^3/\text{s}$  pada kedalaman aliran  $0.15 \text{ m}$  menghasilkan sebuah lompatan hidraulik. Kira peratus kehilangan tenaga akibat lompatan hidraulik tersebut.

3. [b] Figure 2 shows flow in Sg Muda during flood of 6<sup>th</sup> October 2003 at a flow discharge of  $1340 \text{ m}^3/\text{s}$ . If the Manning roughness coefficient for the main channel is  $0.03$  and the flood plain  $0.05$ , calculate the channel slope to carry the flood discharge.

(10 marks)

3. [b] Rajah 2 menunjukkan aliran dalam Sg. Muda ketika banjir pada 6 Oktober 2003 dengan luahan  $1340 \text{ m}^3/\text{s}$ . Jika pekali kekasaran Manning bagi saluran utama dan dataran banjir adalah masing-masing  $0.03$  dan  $0.05$ , kira cerun saluran bagi membawa luahan banjir tersebut.

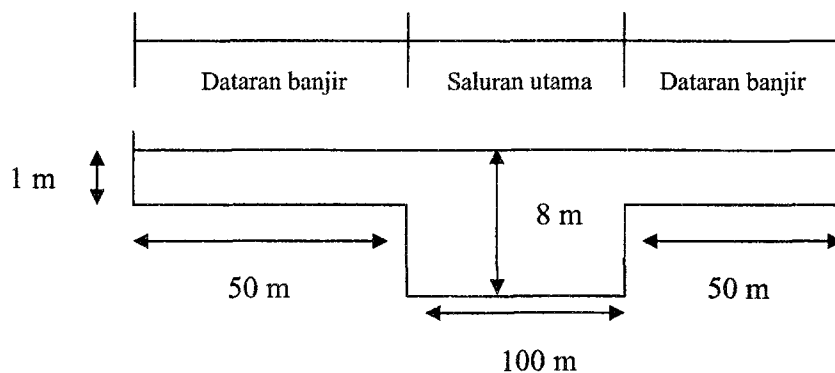


Figure 2 (Rajah 2)

3. [c] Design a rectangular concrete channel with the following characteristics:

Discharge	= $20 \text{ m}^3/\text{s}$
Channel slope	= $0.025$
Manning's n	= $0.013$

(5 marks)

3. [c] Rekabentukkan sebuah saluran konkrit berbentuk segiempat dengan ciri-ciri berikut:

Luahan	= $20 \text{ m}^3/\text{s}$
Cerun saluran	= $0.025$
Pekali Manning	= $0.013$

4. The flow characteristics for Sungai Kulim are as follows:

Discharge	= 20 m <sup>3</sup> /s
Channel width	= 40 m
Channel slope	= 0.00125
Flow velocity	= 0.6 m/s
Flow depth	= 1.0 m
Mean sediment size	= 2.5 mm
Total bed material load	= 4.0 kg/s

4. *Ciri aliran bagi Sungai Kulim adalah seperti berikut:*

<i>Luahan</i>	= 20 m <sup>3</sup> /s
<i>Lebar saluran</i>	= 40 m
<i>Cerun saluran</i>	= 0.00125
<i>Halaju aliran</i>	= 0.6 m/s
<i>Kedalaman aliran</i>	= 1.0 m
<i>Purata saiz endapan</i>	= 2.5 mm
<i>Jumlahan Beban Endapan</i>	= 4.0 kg/s

[a] Examine if bed erosion occurs using Shields diagram given in Figure 1.

(8 marks)

[a] *Semak jika hakisan dasar berlaku dengan menggunakan Diagram Shields dalam Jadual 1.*

[b] Compute bed load rate using Einstein-Brown equation.

(7 marks)

[b] *Kira beban endapan dasar dengan menggunakan persamaan Einstein-Brown.*

[c] Compute total bed material load using Graf equation.

(5 marks)

[c] *Kira jumlahan beban endapan dengan menggunakan persamaan Graf.*

**Jadual 1 : Diagram Shields**

$D_{gr}$	$\frac{\tau_c}{\rho g (S_s - 1) d}$
$D_{gr} \leq 4$	$0.24 D_{gr}^{-0.1}$
$4 < D_{gr} \leq 10$	$0.14 D_{gr}^{-0.64}$
$10 < D_{gr} \leq 20$	$0.04 D_{gr}^{-0.10}$
$20 < D_{gr} \leq 150$	$0.013 D_{gr}^{0.29}$
$D_{gr} > 150$	0.055

5. [a] Explain Buckingham Pi Theorem. (4 marks)
5. [a] *Terangkan Teori Buckingham Pi.*
5. [b] Define the terms Similitude and Dimensional Analysis. (4 marks)
5. [b] *Nyatakan terma berikut; Similitud dan Analisis Berdimensi.*
5. [c] A spillway for a dam is 20 m wide and is designed to carry  $125 \text{ m}^3/\text{s}$  at flood stage. A 1:15 model is constructed to study the flow characteristics through the spillway. The effects of surface tension and viscosity are to be neglected.
- (i) Determine the required model width and flow rate.
- (ii) Determine the operating time for the model that corresponds to a 24-h period in the prototype. (12 marks)
5. [c] *Sebuah alurlimpah sebuah empangan adalah 20 m lebar dan direkabentuk untuk mengalirkan  $125 \text{ m}^3/\text{s}$  semasa banjir. Sebuah model 1:15 dibina. Untuk mengkaji ciri aliran melalui alurlimpah tersebut. Abaikan kesan daya lekit permukaan dan kelikatan.*
- (i) *Tentukan lebar dan kadar alir model tersebut.*
- (ii) *Tentukan masa operasi model tersebut untuk jangkamasa 24-jam bagi prototaip.*
6. [a] Distinguish between a pump and a turbine. (5 marks)
6. [a] *Bezakan antara sebuah pam dan turbin.*
6. [b] A Pelton turbine rotates at an angular speed of 400 rpm, developing 67500 watts under a head of 60 m of water. The operating conditions are, velocity coefficient  $C_v = 0.97$ , speed factor  $\phi = 0.46$ , and efficiency  $\eta = 83\%$ . Determine:
- (i) the volumetric flow rate
- (ii) the Pelton wheel diameter (15 marks)
6. [b] *Sebuah turbin Pelton berputar selaju 400 rpm dan menghasilkan 67500 watts di bawah turus 60 m. Operasi turbin tersebut adalah seperti berikut pekali kelajuan  $C_v = 0.97$ , faktor kelajuan  $\phi = 0.46$ , dan kecekapan  $\eta = 83\%$ . Tentukan:*
- (i) *kadar alir isipadu*
- (ii) *garis pusat roda Pelton*

