Second Semester Examination
2018/2019 Academic Session

June 2019

EAH225 – Hydraulics
(Hidraulik)

Duration : 3 hours
(Masa : 3 jam)

Please check that this examination paper consists of **ELEVEN (11)** pages of printed material including appendix before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEBELAS (11)** muka surat yang bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]*

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

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

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

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

1. (a). Explain the relationship of friction factor in a Moody Diagram with pipe and fluid characteristics.

Terangkan hubungan faktor geseran dalam Rajah Moody dengan ciri-ciri paip dan bendalir.

[4 marks/*markah*]

(b). Determine the elevation required in the upper reservoir to produce a water discharge of 385 L/s in the pipe system as shown in **Figure 1**. Total loss includes major losses, minor losses at the entrance; exit and sharp bending should be considered. Assume the loss coefficient of sharp bending is 0.25.

*Tentukan keperluan ketinggian takungan atas untuk menghasilkan kadaralir 385 L/s dalam sistem paip tersebut seperti yang ditunjukan di **Rajah 1**. Jumlah kehilangan termasuk kehilangan major, kehilangan minor, alur masuk dan keluar, dan siku tajam perlu diambil kira. Andaikan nilai pemalar kehilangan siku tajam adalah 0.25.*

[8 marks/*markah*]

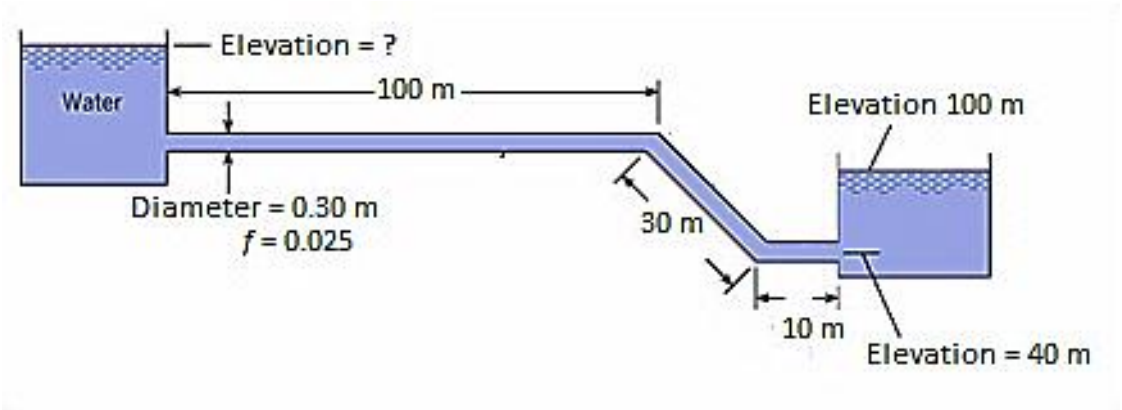

Figure 1 / *Rajah 1*

(c). A tank transmits 100 L/s of water to point C where the pressure is maintained at 150 kPa at points A and B as shown in **Figure 2**. The first part AB of the pipeline is 50 cm diameter and 2.5 km long, and the second part BC is 25 cm diameter and 1.5 km long. All pipes are made of HDPE and minor loss of pipe contraction is 0.85. Assuming C is the datum, determine the water level (L) in the tank.

*Sebuah tangki mengalirkan 100 L/s air ke titik C dimana tekanan dikekalkan pada 150 kPa di titik A dan B seperti yang ditunjukkan di **Rajah 2**. Bahagian pertama AB salur paip bergaris pusat 50 cm dan 2.5 km panjang, dan bahagian kedua BC adalah 25 cm garis pusat dan 1.5 km panjang. Semua paip diperbuat daripada HDPE dan kehilangan kecil pengecutan paip adalah 0.85. Andaikan C ialah datum, tentukan paras air (L) dalam tangki.*

[8 marks/*markah*]

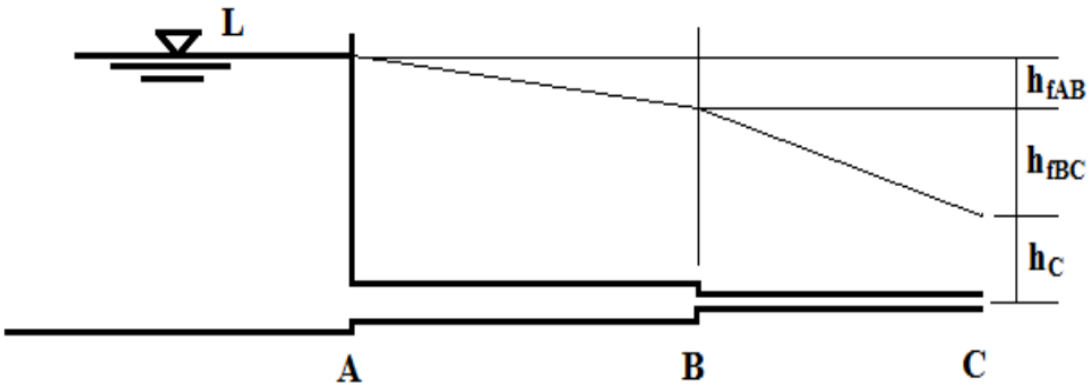

Figure 2 / *Rajah 2*

2. (a). A 20 cm diameter galvanised iron (e = 0.15 mm) pipe is 1500 m long and discharges water into the atmosphere (horizontal) with a head loss of 2.5 m/km. Determine the pipe discharge.

Sebatang paip besi tetuang bergaris pusat 20 cm (e= 0.15 mm) sepanjang 1500 m mengalirkan air ke udara (mengufuk) dan mempunyai kehilangan turus sebanyak 2.5 m/km. Tentukan kadar alir paip tersebut.

[5 marks/*markah*]

(b). HDPE pipe of 250 m long with 10 cm in diameter is fitted to a water tank as shown in **Figure 3**. The water discharges into the atmosphere through a 10 cm diameter nozzle. Calculate the flow rate and the pressure at B by neglecting all minor losses in the pipe and nozzle.

*Paip HDPE sepanjang 250 m bergaris pusat 10 cm disambungkan ke tangki air seperti yang ditunjukkan dalam **Rajah 3**. Air dilepaskan ke atmosfera melalui muncung yang bergaris pusat 10 cm. Kirakan kadar alir dan tekanan pada B dengan mengabaikan semua kehilangan minor di dalam paip dan muncung.*

[8 marks/*markah*]

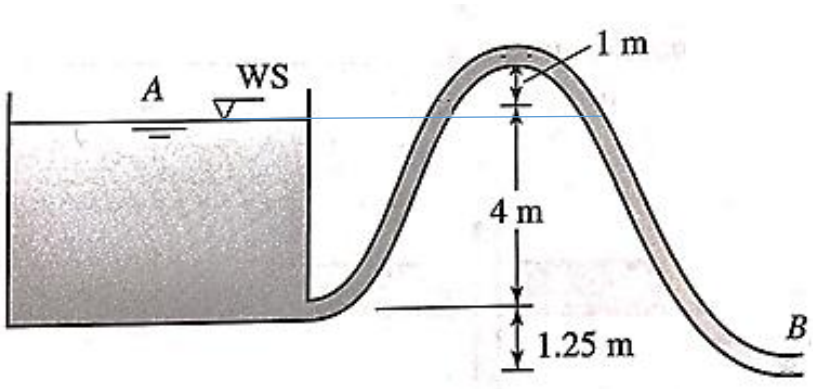

Figure 3 / *Rajah 3*

(c). Two reservoirs as shown in **Figure 4** have 6 m difference in water levels, and are connected by a pipe 60 cm diameter and 3000 m long. Then, the pipe branches into two pipes, each 30 cm diameter and 1500 m long. The friction factor (*f*) of all pipes is 0.01. Neglecting minor losses, determine the flow rates in each pipe.

*Dua takungan seperti yang ditunjukkan dalam **Rajah 4** mempunyai perbezaan turus air sebanyak 6 m, dan disambungkan dengan sebatang paip bergaris pusat 60 cm dan 3000 m panjang. Kemudian, cabangan paip menjadi dua dengan setiap satu bergaris pusat 30 cm dan 1500 m panjang. Faktor geseran (f) bagi semua paip ialah 0.01. Dengan mengabaikan kehilangan minor, tentukan kadar alir dalam setiap paip.*

[7 marks/*markah*]

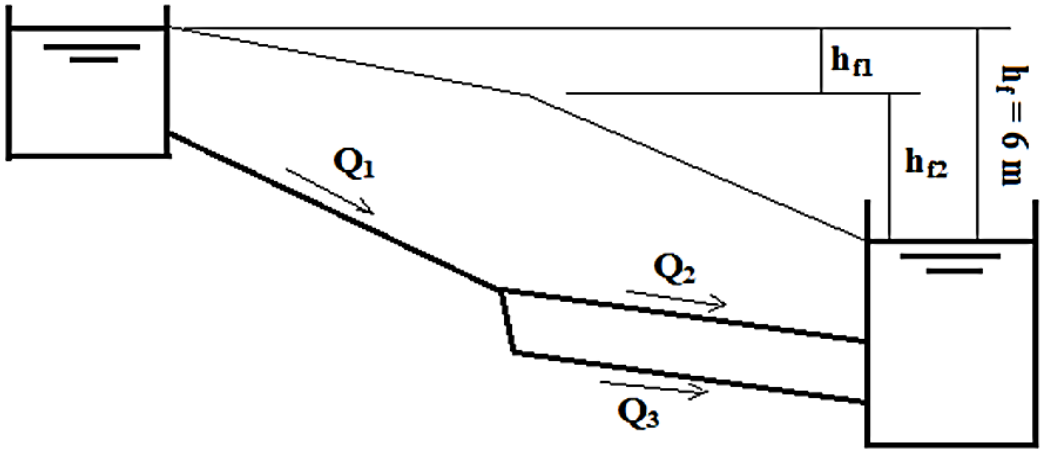

Figure 4 / *Rajah 4*

3. (a). Open channel flow and pipe flow are two different types of flow. Differentiate open channel flow from pipe flow.

Aliran saluran terbuka dan aliran paip adalah dua jenis aliran yang berbeza. Bezakan aliran saluran terbuka daripada aliran paip.

[5 marks/*markah*]

(b). A float-finished concrete channel as shown in **Figure 5**, was designed for water to flow at a rate of 40 m^3/s. Determine the required longitudinal slope of the channel bottom per kilometer of length.

*Saluran konkrit kemasan terapung seperti yang ditunjukkan dalam **Rajah 5**, direka bentuk untuk aliran air pada kadar 40 m^3/s. Tentukan kecerunan longitudinal yang diperlukan oleh dasar saluran bagi setiap kilometer panjang.*

[7 marks/*markah*]

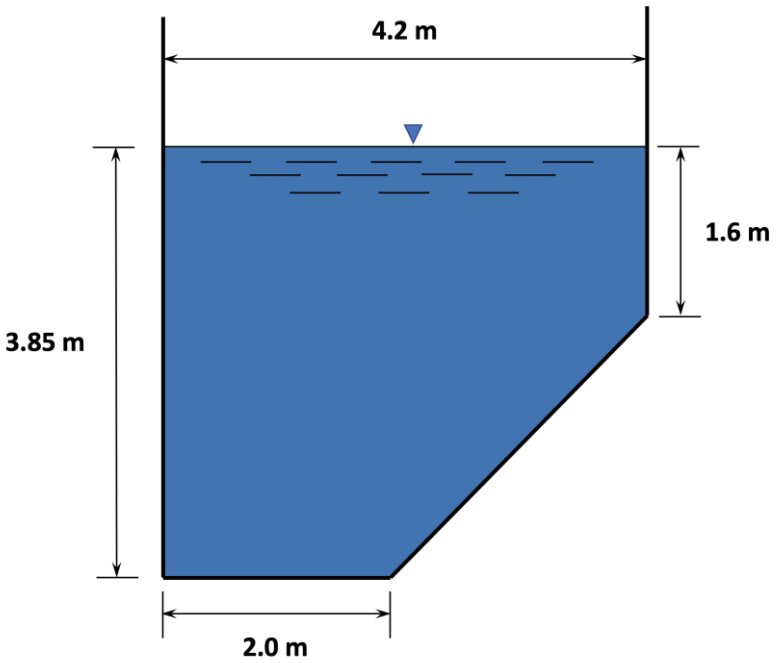

Figure 5/ *Rajah 5*

(c). A rectangular channel of formed-unfinished concrete with has a flowrate of 6.75 m^3/s in the channel. The slope along the channel is 1.25%. Design the channel so that the normal depth is half of the width of the channel.

Sebuah saluran segi empat tepat pada konkrit terbentuk tiada kemasan mempunyai aliran 6.75 m^3/s mengalir di dalamnya. Cerun di sepanjang saluran adalah 1.25%. Reka bentuk saluran supaya kedalaman normal adalah separuh dari lebar saluran.

[8 marks/*markah*]

4. (a). Froude number (F_r) and specific energy (E_s) are important parameters in hydrodynamics. Define Froude number and specific energy. Sketch and explain the following:

Nombor Froude (F_r) dan tenaga tertentu (E_s) *adalah parameter penting dalam hidrodinamik. Definasikan nombor Froude dan tenaga tentu. Lakar dan terangkan yang berikut:*

(i). Discharge versus depth curve for a constant specific energy.

Lengkung kadar alir berbanding kedalaman untuk tenaga tentu malar.

(ii). Specific energy versus depth curve for a constant discharge.

Lengkung tenaga tentu berbanding kedalaman untuk kadar alir malar.

[8 marks/*markah*]

(b). A horizontal channel of 2.2 m wide is equipped with a sluice gate. Water passes under the sluice gate with the depths of 1.85 m and 0.35 m on upstream and downstream of the sluice gate, respectively. A hydraulic jump occurs a short distance downstream of the sluice gate. Assuming no energy loss at the gate, determine:

Sebuah saluran mendatar 2.2 m lebar dilengkapi dengan kunci air. Air melalui bawah kunci air dengan kedalaman masing-masing 1.85 m dan 0.35 m di hulu dan hilir. Lompatan hidraulik berlaku berhampiran bahagian hilir kunci air. Dengan mengandaikan tiada kehilangan tenaga di kunci air, tentukan:

(i). the depth of flow downstream of the hydraulic jump;
kedalaman aliran di hilir lompatan hidraulik;

(ii). energy that is dissipated (%) in the hydraulic jump.
tenaga yang hilang (%) dalam lompatan hidraulik.

[12 marks/*markah*]

5. (a). The drag force (*F*) on a body in supersonic flow depends on the length (*L)*, velocity (*V)*, diameter (*D)* and fluid properties such as density (*ρ)*, dynamic viscosity (*μ*) and bulk modulus of elasticity (*E)*. Derive an expression for *F*.

Daya seret (F) pada badan dalam aliran supersonik bergantung kepada panjang (L), halaju (V), garis pusat (D) dan sifat bendalir seperti ketumpatan (ρ), kelikatan dinamik μ dan modulus pukal keanjalan (E). Terbitkan ungkapan untuk F.

[10 marks/*markah*]

(b). The pressure drop in a flow meter in which oil flows at an upstream velocity of 0.9 m/s is to be estimated by model studies. A 1:6 scale model using water is used. If the pressure drop in the model is 450 Pa, determine the pressure drop in the prototype. If the prototype discharge is 200 L/s, determine the model discharge. The following values are relevant:

Penurunan tekanan di dalam meter aliran yang mengalirkan minyak pada halaju huluan 0.9 m/s dianggarkan dengan model kajian. Model berskala 1:6 menggunakan air digunakan. Jika kejatuhan tekanan dalam model adalah 450 Pa, tentukan nilai jatuhan tekanan prototaip. Jika kadar aliran prototaip adalah 200 L/s, tentukan kadar aliran model. Nilai-nilai berikut adalah berkaitan:

Item/ *Perkara*	Prototype/*Prototaip*	Model/ *Model*
Density/*Ketumpatan*	700 kg/m^3	998 kg/m^3
Viscosity/*Kelikatan*	0.102 Pa.s	1 x 10^{-3} Pa.s

(The Reynolds model law is applicable)
(Model Reynolds boleh digunakan)

[10 marks/*markah*]

6. (a). With the aid of sketch diagrams, briefly discuss the differences between pump and turbine. Explain several reasons why pump industry offers several choices of impeller diameter.

Dengan bantuan gambar rajah lakaran, bincangkan secara ringkas tentang perbezaan antara pam dan turbin. Terangkan beberapa sebab kenapa industri pam menawarkan beberapa pilihan garis pusat pendesak.

[8 marks/*markah*]

(b). An inward flow reaction has inlet and outlet diameters of 1.2 m and 0.6 m, respectively. The breadth at inlet and outlet are 0.25 m and 0.35 m, respectively. At a rotation speed of 250 rpm, the relative velocity at entrance is 3.5 m/s and is radial. Calculate the following:

Satu reaksi aliran masuk mempunyai diameter masuk dan keluar masing-masing 1.2 m dan 0.6 m. Keluasan di salur masuk dan keluar masing-masing ialah 0.25 m dan 0.35 m. Pada kelajuan putaran 250 rpm, halaju relatif di salur masuk ialah 3.5 m/s dan jejarian. Kirakan yang berikut:

(i). Absolute velocity at entrance and the inclination to the tangent of the pump runner

Halaju mutlak di salur masuk dan kecondongan terhadap tangen pelari pam

(ii). Discharge

Kadar alir

(iii). The velocity of flow at the outlet

Halaju aliran pada saluran keluar

[12 marks/*markah*]

APPENDIX/*LAMPIRAN*

TABLE 1: Values for Mannings' Coefficient
JADUAL 1: *Nilai untuk pemalar Manning*, ***n***

Values for Manning's *n*	
Channel Description	***n***
Glass, copper, plastic, or other smooth surface	0.010
Smooth, unpainted steel, planed wood	0.012
Painted steel or coated cast iron	0.013
Smooth asphalt, common clay drainage tile, trowel-finished concrete, glazed brick	0.013
Uncoated cast iron, black wrought iron pipe, vitrified clay sewer tile	0.014
Brick in cement mortar, float-finished concrete, concrete pipe	0.015
Formed, unfinished concrete, spiral steel pipe	0.017
Smooth earth	0.018
Clean excavated earth	0.022
Corrugated metal storm drain	0.024
Natural channel with stones and weeds	0.030
Natural channel with light brush	0.050
Natural channel with tall grasses and reeds	0.060
Natural channel with heavy brush	0.100

$$u = \frac{\pi DN}{60}$$

$$Q = \pi D_1 b_1 V_{f1}$$

$$E = ML^{-1}T^{-2}$$

$$\mu = ML^{-1}T^{-1}$$

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