UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2009/2010 Academic Session

April/May 2010

EAH 225/3 – Hydraulics
[*Hidraulik*]

Duration : 3 hours
[*Masa : 3 jam*]

Please check that this examination paper consists of **TWELVE (12)** pages of printed material including appendix before you begin the examination.
[*Sila pastikan bahawa kertas peperiksaan ini mengandungi* ***DUA BELAS (12)*** *muka surat yang bercetak sebelum anda memulakan peperiksaan ini.*]

Instructions : This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions only. All questions carry the same marks.

[***Arahan*** *: Kertas ini mengandungi* ***ENAM (6)*** *soalan. Jawab* ***LIMA (5)*** *soalan sahaja. Semua soalan membawa jumlah markah yang sama.*

You may answer the question either in Bahasa Malaysia or English.
[*Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Enggeris*].

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 river reach has the following characteristics:

Channel shape = rectangular

Discharge,	Q =	200 m^3/s
Channel width,	b =	50 m
Flow depth,	y =	5 m
Bed slope,	So=	0.0003
Sediment mean diameter,	d_{50} =	0.01 m
Measured bedload	Qm=	8.823 kg/s

a) Estimate the bedload using Shield and Einstein-Brown formulae.

[16 marks]

b) Determine which sediment transport formula is suitable for this river reach.

[4 marks]

Use;

kinematic viscosity,	ν =	0.000001 m^2/s
density of water,	ρ =	1000 kg/m^3
density of sediment,	ρs =	2650 kg/m^3

2. A 20m wide rectangular channel carries water with a mean depth of 1.0m and slope of 0.00025. The mean diameter of the bed material is 0.40 mm.

a) Using the Shield diagram (Figure 1), determine the bed form. [5 marks]

b) Examine the bed stability. [5 marks]

c) Calculate the flow discharge using Sugio's equation. [5 marks]

Use;

kinematic viscosity,	ν =	0.000001 m^2/s
density of water,	ρ =	1000 kg/m^3
density of sediment,	ρs =	2650 kg/m^3

d) From Figure 2, list the mode of sediment transport.

[5 marks]

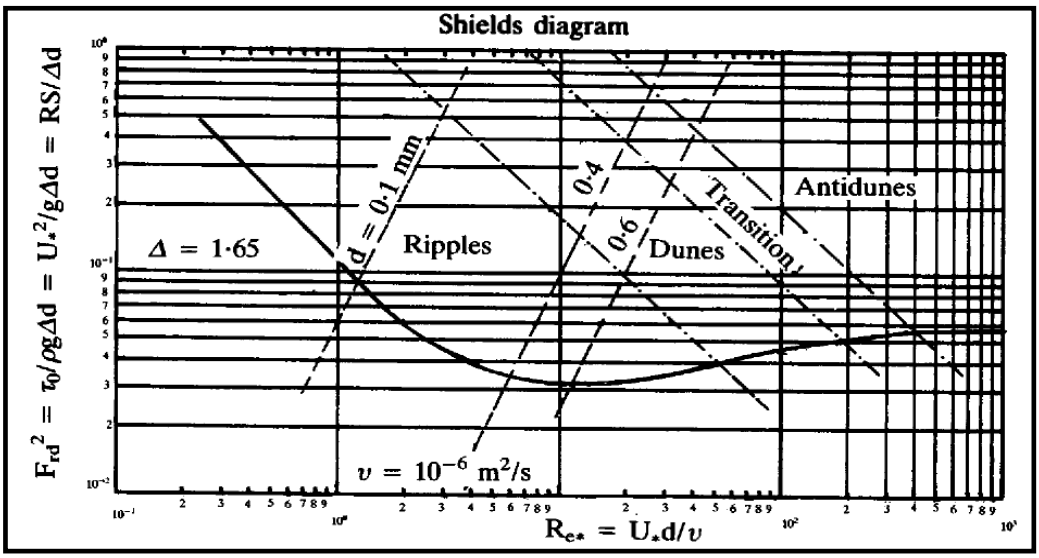


Figure 1

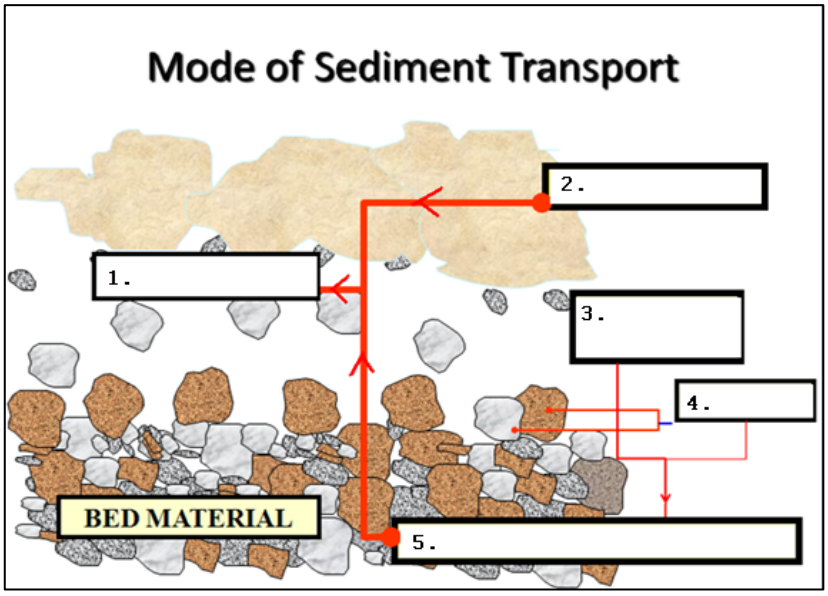


Figure 2

3. a) Explain the significance of specific speed in tubine selection.

[5 marks]

b) The power '*p*' of any rotary hydraulic machine (pump or motor) depends upon the density '*p*' the speed 'N', the characteristic diameter 'D', the head change 'ΔH', the volume flow rate 'Q' and the gravitational constant '*g*'. Use Buckingham $\prod$ theorem to derive function form.

[10 marks]

c) The pressure drop per unit length 'p' due to friction in pipe depends upon the diameter 'D', the mean velocity 'v', the density 'p' and the dynamic viscosity 'μ'. Find relationship between the variables.

[5 marks]

4. a) What are the factors for specifying a freeboard for open channel design purpose?

[4 marks]

b) What are the specification of freeboard for the following open channels?

i. Rectangular

ii. Trapezoidal

iii. Earth

[6 marks]

c) A flood diversion channel must be designed to carry a peak flood discharge of $150m^3/s$. The topography dictates a slope of 0.0005 and the channel is to be lined with concrete (n = 0.015). The maximum bed width available is 25m. The soil test shows that excavation will encounter rock at a depth of 4.0m. Determine the dimensions of a rectangular channel for the diversion channel.

[10 marks]

5. A 200mm diameter pipeline, 5000m long and of effective roughness 0.03mm delivers water between reservoirs the minimum difference in water level between which is 40 m.

a) Considering only friction, entry and velocity head losses into account, determine the steady discharge between the reservoirs.

[8 marks]

(b) If the discharge is to be increased to 50 l/s without increase in gross head, determine the length of 200 mm diameter pipeline of effective roughness 0.015 mm to be fitted in parallel. Consider only friction losses. Refer to Figure 3.

[12 marks]

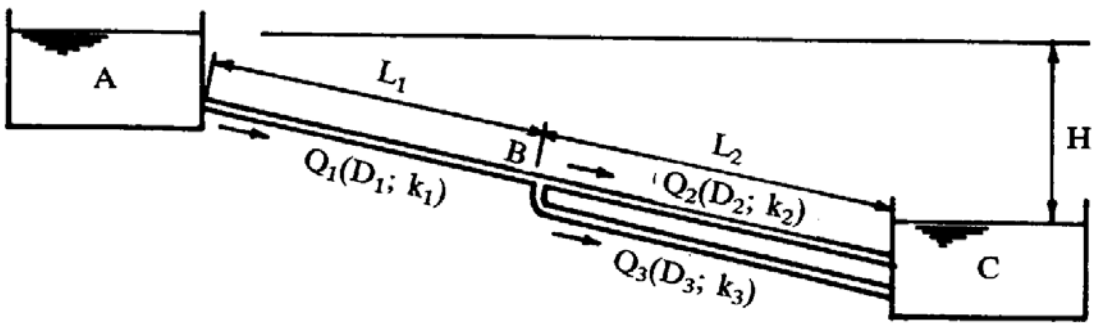


Figure 3

6. (a) Describe the different in

i. pipe in parallel and pipe in series in term of head and discharge.

ii. minor losses and major losses

[5 marks]

(b) A constant head tank delivers water through a uniform pipeline to a tank, at a lower level, from which the water discharges over a rectangular weir. Pipeline length is 20m, diameter 100mm, roughness 0.2mm. Length of weir crest 0.25m, discharge coefficient 0.6, cress level 2.5m below water level in header tank. Calculate the steady discharge and the head of water over the weir cress. Refer to Figure 4.

Note / *Nota* :

Discharge over weir: $Q = \frac{2}{3} C_D \sqrt{2g}\, B\, h^{3/2}$

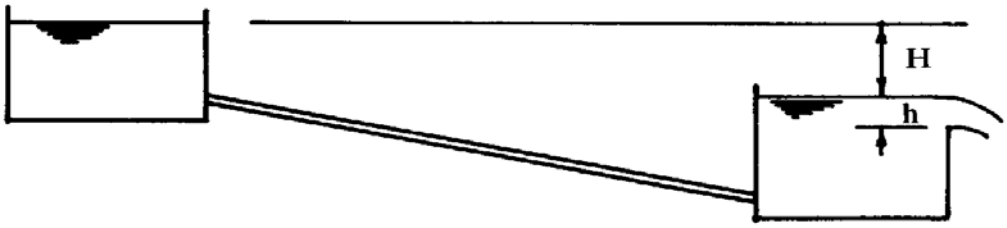


Figure 4

1. *Sebatang ruas sungai mempunyai ciri-ciri berikut:*

Bentuk saluran = segi empat		
Kadaralir,	$Q =$	$200\ m^3/s$
Lebar saluran,	$b =$	$50\ m$
Kedalaman aliran,	$y =$	$5\ m$
Cerun saluran,	$So =$	0.0003
Garispusat purata endapan,	$d_{50} =$	$0.01\ m$
Beban dasar cerapan	$Qm =$	$8.823\ kg/s$

c) *Kira beban dasar menggunakan persamaan Shield dan Einstein-Brown.*

[16 markah]

d) *Tentukan persamaan pengangkutan endapan yang sesuai untuk ruas sungai ini.*

[4 markah]

Guna;

kelekitan kinematik,	$\nu =$	$0.000001\ m^2/s$
ketumpatan air,	$\rho =$	$1000\ kg/m^3$
ketumpatan endapan,	$\rho s =$	$2650\ kg/m^3$

2. *Sebuah saluran 20m lebar menyalirkan air dengan kedalaman aliran 1.0m dan cerun aliran 0.00025. Garispusat purata endapan 0.40mm.*

a) *Tentukan bentuk dasar dengan menggunakan Rajah 1.* *[5 markah]*

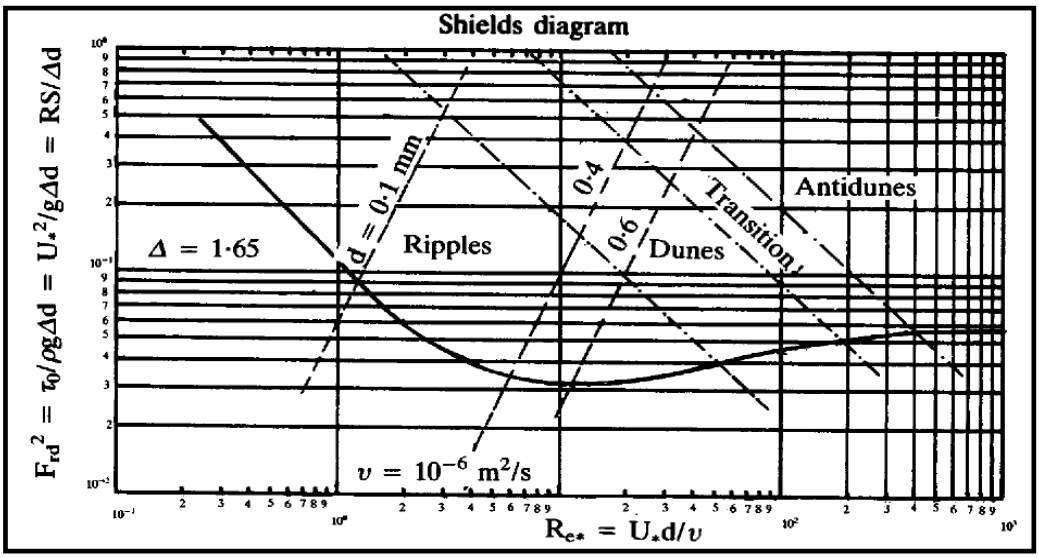
b) *Semak kestabilan dasar.* *[5 markah]*

c) *Kira kadaralir menggunakan persamaan Sugio.* *[5 markah]*

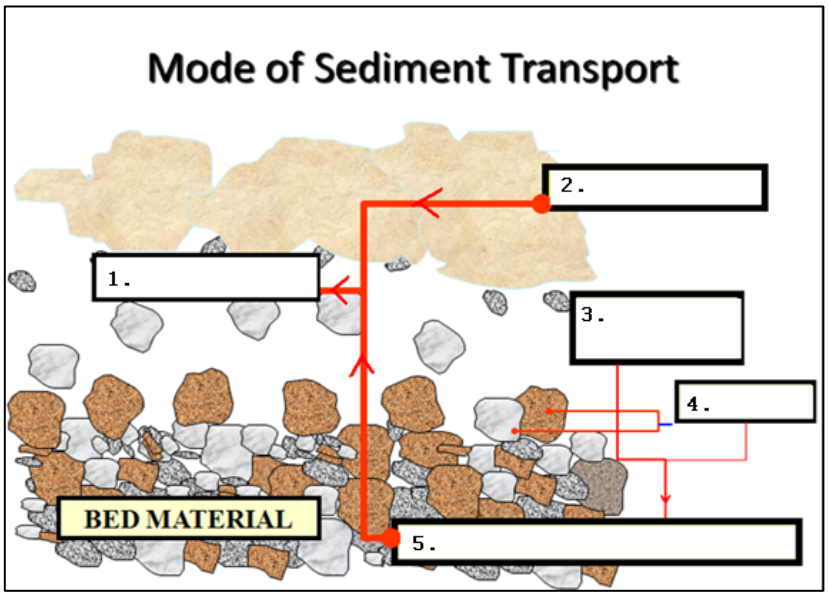
Guna;

kelekitan kinematik,	$\nu =$	$0.000001\ m^2/s$
ketumpatan air,	$\rho =$	$1000\ kg/m^3$
ketumpatan endapan,	$\rho s =$	$2650\ kg/m^3$

d) *Dari Rajah 2, senaraikan ragam pengangkutan endapan.* *[5 markah]*



Rajah 1



Rajah 2

3. a) *Jelaskan kepentingan laju tentu untuk pemilihan turbin.*

[5 markah]

b) *Kuasa 'p' mana-mana mesin hidraulik berputar (pam atau enjin) bergantung di atas ketumpatan 'ρ' kelajuan 'N' , garis pusat ciri 'D' , perubahan kepala '△ H', kadar aliran jumlah 'Q' dan pemalar graviti 'g'. Gunakan Buckingham ∏ teorem untuk mendapatkan bentuk fungsian.*

[10 markah]

c) *Susutan tekanan setiap panjang unit 'p' kerana geseran dalam paip bergantung di atas garis pusat 'D', halaju min 'v' , ketumpatan 'ρ' dan kelikatan dinamik 'μ'. Hubungan penemuan antara pembolehubah-pembolehubah itu.*

[5 markah]

4. a) *Apakah faktor-faktor yang membuatkan papan bebas perlu diambilkira dalam rekabentuk saluran terbuka?*

[4 markah]

b) *Apakah spesifikasi papan bebas bagi jenis saluran terbuka berikut?*

i. *Segiempat tepat*
ii. *Trapezoid*
iii. *Tanah*

[6 markah]

c) *Sebuah saluran lencongan perlu direkabentuk untuk membawa luahan puncak 150m^3/s. cerun saluran berdasarkan mukabumi adalah 0.0005 dan saluran adalah tegar dieperbuat dari konkrit (n = 0.015). Lebar saluran maksimum adalah 25m. ujian tanah menunjukkan lapisan batu pada kedalaman 4.0m. tentukan dimensi saluran segiempat tepat bagi saluran lencongan tersebut.*

[10 markah]

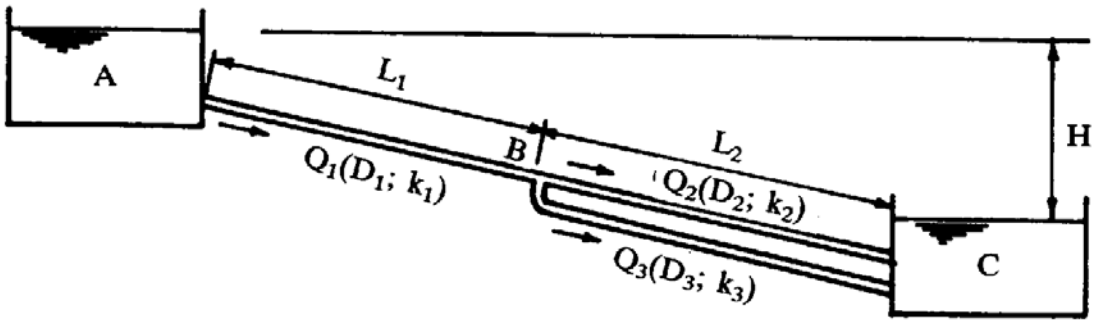
5. *Sebatang paip berdiameter 200mm, 5000m panjang dan kekasaran efektif 0.03mm berupaya untuk menghantar air antara dua reservor yang mempunyai perbezaan ketinggian 40 m.*

a) *Dengan mempertimbangkan daya geseran, kehilangan masuk dan turus halaju, tentukan nilai kadar alir tetap antara dua reservor.*

[8 markah]

b) *Sekiranya kadar alir dinaikkan kepada 50 l/s tanpa meningkatkan nilai turus kasar, tentukan panjang paip berdiameter 200 mm sekiranya kekasaran efektif adalah 0.015 mm dan diletakkan secara selari. Andaikan hanya kehilangan major. Rujuk Rajah 3.*

[12 markah]



Rajah 3

6. a) *Terangkan perbezaan bagi:*

   i. *Paip selari dan bersiri untuk turus dan kadar alir*

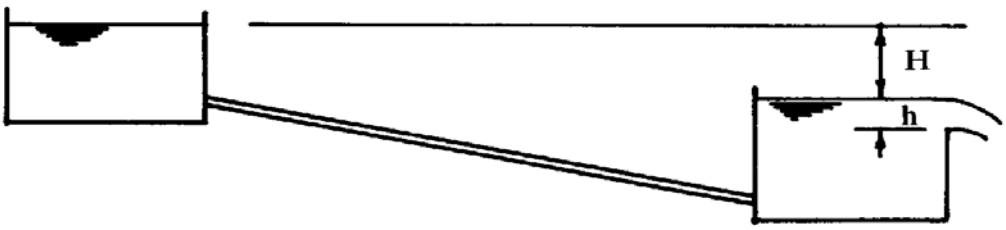
   ii. *Kehilangan nimor dan major*

[5 markah]

b) *Sebuah tangki yang mempunyai turus malar mengalirkan air melalui sebatang paip ke sebuah tangi lain yang terletak diaras lebih bawah dimana air ynag mengalir melalui sebuah takuk segiempat. Batang paip tersebut adalah 20 m panjang, berdiameter 100mm dan kekasaran paip adalah 0.2mm. Panjang takuk tersebut adalah 0.25m mempunyai pemalar aliran 0.6 dan paras kress adalah 2.5m dibawah tangki yang berada diparas atas. Tentukan nilai kadaralir malar dan turus air di kres takuk . Rujuk Rajah 4.*

Nota :

Discharge over weir: $Q = \frac{2}{3} C_D \sqrt{2g}\, B\, h^{3/2}$



Rajah 4

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APPPENDIX