UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2010/2011

COURSE NAME	:	HYDRAULICS
COURSE CODE	:	BFC 2073/ BFC 21103
PROGRAMME	:	2 BFF
EXAMINATION DATE	:	NOVEMBER/DECEMBER 2010
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS PAPER CONSISTS OF **ELEVEN (11)** PAGES

Q1. (a) Justify the difference between:
(i) Uniform flow and non-uniform flow
(ii) State of flow using Reynolds Number (R_e) and Froude Number (F_r)

(6 marks)

(b) A concrete lined trapezoidal channel with uniform flow in Figure Q1 has a normal depth, $y_0 = 4$ m. The base width is $2y_0$ m and the bed slope, $S_0 = 0.001$. Manning's n can be taken as 0.015. Caculate;
(i) Discharge, Q
(ii) Mean velocity, V
(iii) Reynold number R_e (if kinematic viscosity υ is 10^{-4} m^2/s)

(14 marks)

Q2. (a) Based on Figure Q1 and using section factor equation, prove that;

$$Z = \left(4.58y^2 + 10y\right)\left[\frac{4.58y^2 + 10y}{8.12y}\right] = 15.94$$

when the discharge of the uniform flow is 34 m^3/s, with the same bed slope S_0 = 0.001 and Manning coefficient $n = 0.015$.

(10 marks)

(b) Determine the depth of flow y_o of the channel if the best hydraulic section is needed for a composite section open channel in Figure Q2 is designed to convey 6.5 m^3/s of water. Manning coefficient n and bed slope are given as 0.015 and 0.0015 respectively.

(10 marks)

Q3 (a) Explain briefly the classification of the types water surface profiles based on the normal water depth y_o and the critical water depth y_c.

(8 marks)

(b) Water flows in a 50 m wide and 5 m deep rectangular channel with bottom slope S_o = 0.001 and Manning roughness coefficient $n = 0.015$. A weir constructed downstream caused backwater as shown in Figure Q3. Using the direct step method, determine:
(i) the distance L, and
(ii) the type of flow profile.

(12 marks)

Q4 (a) List five (5) applications of hydraulic jump in engineering works.

(5 marks)

(b) A 30-m wide spillway carries flow with velocity of 20 m/s and flow depth of 1 m. Hydraulic jump occurs immediately downstream. Determine:
(i) the height of the jump, and
(ii) the power loss in the jump.

(7 marks)

(c) A spillway discharges flow at a rate of 8 $m^3/s/m$. Downstream of the spillway, the depth of flow is 0.3 m. Determine the tailwater depth that is require to form a hydraulic jump. If a jump occurs, determine:
(i) the type of the jump,
(ii) the length of the jump, and
(iii) the head loss due to the jump.

(8 marks)

Q5 (a) Explain briefly;
(i) sharp crested weir
(ii) spillway
(iii) sluice gate

(6 marks)

(b) A sluice gate was built at rectangular channel with 2.3 m width. The normal depth, y_o = 2.0 m, coefficient of drop and coefficient of discharge are given as 0.625 and 0.61 respectively. Calculate the discharge across the gate if the height of gate opening is 0.5 m and upstream depth is 1.5 m.

(6 marks)

(c) Referring to Figure Q5, channel flow is controlled by a trapezoidal notch to ensure the full supply of 2.0 m^3/s flows over the notch at a head of 1.2 m measured over the crest. At head of 0.6 m, a discharge of 0.6 m^3/s passes over the notch. Calculate the base width, L and angle of side slopes, θ of the notch.

(8 marks)

Q6. (a) What are the functions of pump and turbine?

(3 marks)

(b) Justify the relationship between head (H), efficiency (η) and power (P) for a centrifugal pump with the aid of diagram.

(7 marks)

(c) A turbine of diameter 3 m develops 6750 kW at 300 rpm under a net head of 45 m. A geometrically similar model of scale ratio 1: 8 is is tested at a head of 9 m. Determine the size, speed, discharge, power and specific speed developed by the model if the overall efficiency for both prototype and model are 82%.

(10 marks)

S1. (a) Huraikan perbezaan di antara:

(i) Aliran seragam dan aliran tak seragam

(ii) Keadaan rejim aliran ketika menggunakan nombor Reynolds Number (R_e) dan Froude Number (F_r)

(6 markah)

(b) Sebuah saluran trapezoid berkonkrit dengan aliran seragam seperti yang ditunjukkan di dalam Rajah S1 mempunyai kedalaman normal, $y_0 = 4$ m. Lebar dasar, B adalah $2y_0$ m dan cerun dasar, $S_0 = 0.001$. Pekali Manning n adalah 0.015. Kira;

(i) Kadaralir Q

(ii) Halaju V

(iii) Nombor Reynold R_e (jika kelikatan kinematik v adalah 10^{-4} m^2/s)

(14 markah)

S2. (a) Berdasarkan Rajah S1, dengan menggunakan persamaan faktor keratan, buktikan bahawa

$$Z = \left(4.58y^2 + 10y\right)\left[\frac{4.58y^2 + 10y}{8.12y}\right] = 15.94$$

apabila kadaralir bagi aliran seragam adalah 34 m^3/s, dengan menggunakan cerun dasar yang sama, $S_0 = 0.001$ dan pekali Manning, $n = 0.015$.

(10 markah)

(b) Tentukan kedalaman normal y_o aliran jika keratan hidraulik berkesan bagi saluran diperlukan bagi satu keratan saluran terbuka campuran seperti ditunjukkan dalam Rajah S2 telah direkabentuk untuk membawa air sebanyak 6.5 m^3/s. Diberi pekali Manning $n = 0.015$ dan cerun dasar $S_o = 0.0015$.

(10 markah)

S3. (a) Jelaskan secara ringkas pengkelasan jenis profil permukaan air yang berdasarkan ukurdalam air normal y_o dan ukurdalam air kritikal y_c.

(8 markah)

(b) Air mengalir dalam sebuah 50 m lebar dan 5 m dalam saluran segiempat dengan kecerunan dasar $S_o = 0.001$ dan pekali kekasaran Manning roughness $n = 0.015$. Sebuah empang dibina di hilir dan menyebabkan air balik seperti dalam Rajah S3. Menggunakan kaedah kamiran terus, kira:

(i) jarak L, dan

(ii) jenis profil aliran tersebut.

(12 markah)

S4. (a) Senaraikan lima (5) aplikasi lompatan hidraulik dalam kerja-kerja kejuruteraan.

(5 markah)

(b) Sebuah 30-m lebar alurlimpah mengalirkan aliran dengan halaju 20 m/s dan ukurdalam air 1 m. Lompatan hidraulik berlaku sebaik tiba di hilir. Kira:

(i) ketinggian lompatan hidraulik, dan

(ii) kehilangan kuasa dalam lompatan hidraulik tersebut.

(7 markah)

(c) Sebuah alurlimpah mengalirkan aliran pada kadar 8 $m^3/s/m$. Ukurdalam aliran di hilir alurlimpah tersebut ialah 0.3 m. Kira kedalaman air ekoran yang diperlukan untuk menghasilkan lompatan hidraulik. Jika lompatan hidraulik berlaku, tentukan:

(i) jenis lompatan tersebut,

(ii) panjang lompatan tersebut, dan

(iii) kehilangan turus yang disebabkan oleh lompatan tersebut.

(8 markah)

S5 (a) Terangkan dengan jelas, apakah;

(i) empang puncak tajam

(ii) alurlimpah

(iii) pintu sluis

(6 markah)

(b) Sebuah pintu sluis dibina di saluran segiempat tepat dengan lebarnya 2.3 m. Diberikan kedalaman normal di saluran tersebut adalah 2.0 m, pekali penurun sebanyak 0.625 dan pekali kadaralir ialah 0.61. Kirakan kadaralir yang melalui pintu sluis jika ketinggian bukaan pintu adalah 0.5 m dan kedalaman di hilir diberikan sebanyak 1.5 m.

(6 markah)

(c) Berdasarkan kepada Rajah S5, aliran saluran dikawal oleh sempak trapezoid untuk memastikan semua bekalan 2.0 m^3/s mengalir melalui sempak pada turus 1.2 m diukur daripada puncak sempak. Ketika turus 0.6 m, kadar alir 0.6 m^3/s telah melepasi sempak itu. Kira lebar dasar, L and sudut cerun sisi, θ untuk sempak tersebut.

(8 markah)

Q6. (a) Apakah fungsi-fungsi pam dan turbin?

(3 markah)

(b) Dengan bantuan rajah, huraikan hubungan antara turus (H), kecekapan (η) dan kuasa (P) untuk sesebuah pam empar.

(7 markah)

(c) Sebuah turbin dengan diameter 3 m menghasilkan 6750 kW dengan 300 rpm pada 45 m. Model yang serupa dari segi geometri dengan skala 1: 8 diuji pada turus 9 m. Kira saiz, kelajuan, kadar alir, kuasa and kelajuan tentu yang dihasilkan oleh model jika kecekapan keseluruhan bagi prototaip dan model ialah 82%.

(10 markah)

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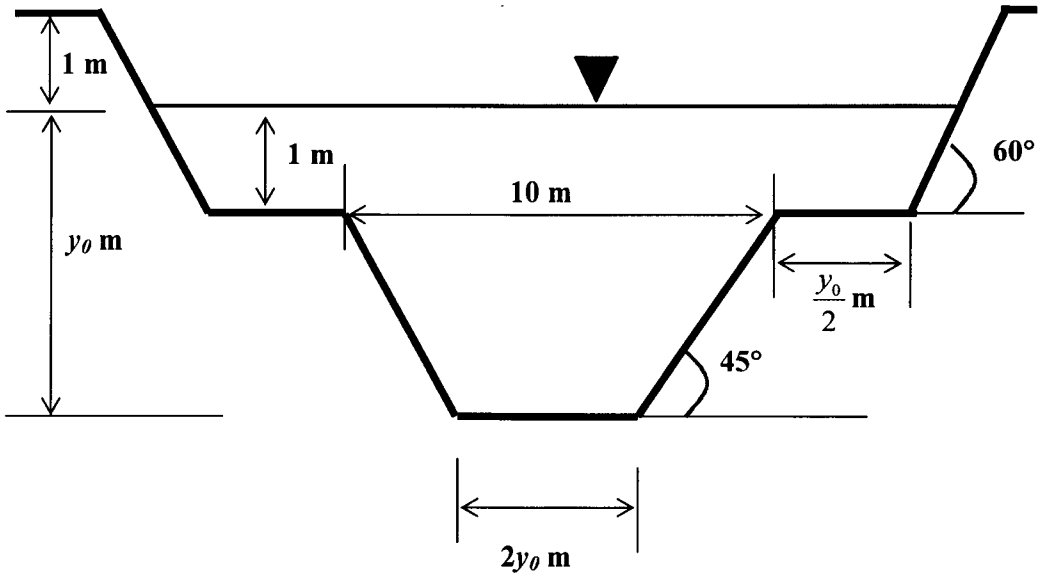

Figure Q1/ Rajah S1

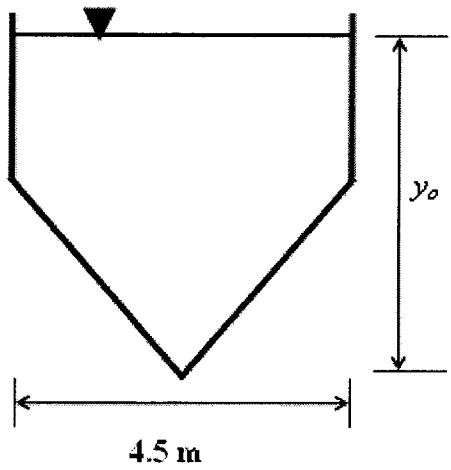

Figure Q2 / Rajah S2

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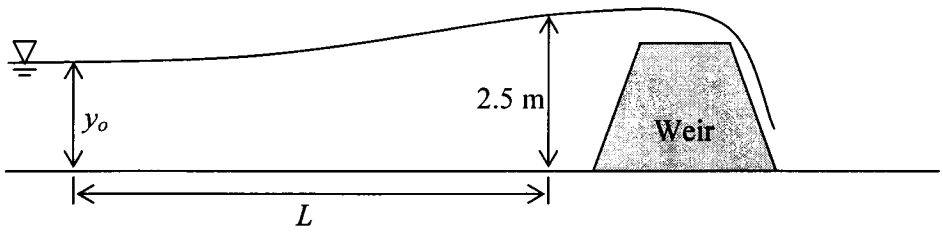

Figure Q3/ Rajah S3

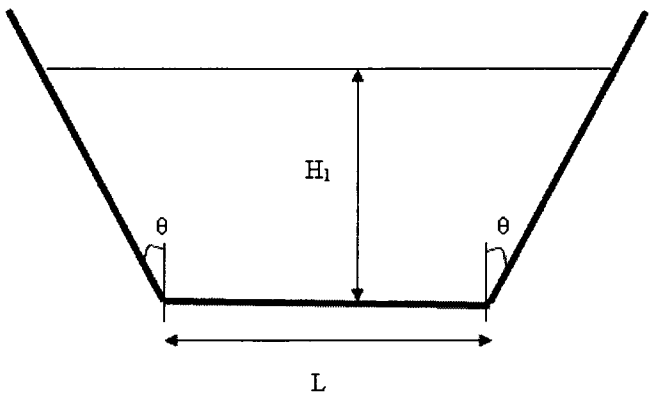

Figure Q5 / Rajah S5

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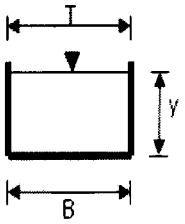
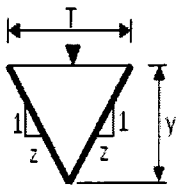
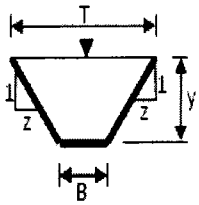
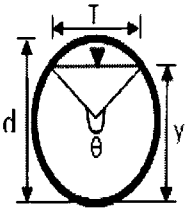
Table 1: Geometry Types for Open Channel

Shape	A	T	P
	By	B	B + 2y
	zy^2	2zy	$2y\sqrt{1+z^2}$
	$By + zy^2$	B + 2zy	$B+2y\sqrt{1+z^2}$
	$\frac{d^2}{8}(\theta - \sin\theta)$ (θ in radian)	$d\left(\frac{\sin\theta}{2}\right)$ (θ in angle)	$\frac{\theta d}{2}$ (θ in radian)

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EQUATION:

$$\left(\frac{NQ^{1/2}}{H^{3/4}}\right)_1 = \left(\frac{NQ^{1/2}}{H^{3/4}}\right)_2$$

$$\left(\frac{Q}{ND^3}\right)_1 = \left(\frac{Q}{ND^3}\right)_2$$

$$\left(\frac{H}{N^2D^2}\right)_1 = \left(\frac{H}{N^2D^2}\right)_2$$

$$Q = \frac{2}{3}C_d\sqrt{2g}H_1^{3/2}\left(L + \frac{4}{5}H_1\tan\theta\right)$$

$$Q = \frac{1}{n}AR^{2/3}S_o^{1/2}$$

$$y_c = \left(\frac{q^2}{g}\right)^{1/3}$$

$$\frac{y_2}{y_1} = \frac{1}{2}\left[-1 + \sqrt{1 + 8F_r^2}\right]$$

$$E_L = \frac{(y_2 - y_1)^3}{4y_1y_2}$$

$$F_r = \frac{V}{\sqrt{gy}}$$

$$P = \gamma QE_L$$

$$E = y + \frac{Q^2}{2gA^2}$$

$$Z = \frac{Q}{\sqrt{g}} = A\sqrt{D}$$

$$P = \eta_o\gamma QH$$

$$P_2 = P_1\left(\frac{H_2}{H_1}\right)^{3/2}$$

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

$$N_2 = N_1\sqrt{H_2/H_1}$$

$$\Delta x = \frac{\Delta E}{S_o - \bar{i}}$$

$$i = \frac{n^2v^2}{R^{4/3}}$$

$$Q = baC_d\sqrt{2g(y_o - y_1)}$$

$y_1 = \psi a$