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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	HYDRAULICS
COURSE CODE	:	BFC 21103
PROGRAMME	:	2 BFF
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

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Q1 (a) Flow inside an open channel is divided into two namely uniform and non-uniform flows. State **FIVE (5)** practical applications why you need to determine these flows.

(5 marks)

(b) Water flows with normal depth at 5.1 m in a rectangular channel lining with concrete (n = 0.023). The channel has 19 m bottom width and bottom slope 0.0048. Calculate the velocity and discharge of this channel.

(5 marks)

(c) A composite channel is designed to flow a 19.8 m^3/s water has characteristics as shown in **Figure Q1(c)**. This channel has to be lining using concrete (n = 0.017) with bed slope, S_o 1:2000. Identify the normal depth using graph method.

(10 marks)

Q2 (a) **Table Q2** shows the variation of roughness coefficient values. Explain your opinion with example why these values are differed from each other.

(5 marks)

(b) Compare the difference between:

(i) The resistance formula; Chezy and Manning
(ii) The normal depth calculation using graph and chart method
(iii) The discharge value calculation in trapezoidal and wide rectangular channel

(6 marks)

(c) A rectangular channel of 4 m wide with Manning's n = 0.035 had badly-damaged surfaces. As a first stage of repair, there are two options of repairing; either to line the channel bed with concrete (n = 0.017) or to re-design using the best hydraulic section. If the depth of flow remains the same at 2.5 m before and after the repair with a bed slope of S_o is 1:1500 :

(i) Identify the changes in discharge obtained for both options as a result of repair
(ii) Prove that this channel will have the maximum discharge Q_{max} using the best hydraulic section method rather than repairing the channel with the concrete lining.

(9 marks)

Q3 (a) Define:

(i) Hydraulic depth
(ii) Specific energy
(ii) Alternate depth
(iii) Hydraulic jump
(iv) Channel constriction

(5 marks)

(b) A prismatic rectangular channel 2 m width carries water at a steady rate of 12 $m^3/s/m$ on a slope S_0 = 0.001 with Manning roughness coefficient $n = 0.02$.

(i) Compute the normal water depth y_0,
(ii) If a broad-crested weir is to be built to control the flow, find the minimum height of the weir.

(5 marks)

(c) A hydraulic jump occurs in a horizontal rectangular channel. If Froude number before the jump, Fr_1 is 12.0 m and energy loss, E_L is 4.2 m, estimate:

(i) Sequence depths, y_1 and y_2
(ii) Height of jump,
(iii) Discharge per meter width,
(iv) Power dissipated per meter width

(10 marks)

Q4 A rectangular channel 5.5 m wide carries water at normal depth of 1.5 m. The bed slope is 1.5 x 10^{-3} and n = 0.017. The channel ends is abrupt drop.

(a) Briefly explain the difference between uniform flow and gradually varied flow.

(3 marks)

(b) Using numerical integration, identify the length L from upstream before the normal depth of flow would fall at 1.4 m. (N, step/section = 3).

(7 marks)

(c) Determine the water-surface profile type.

(3 marks)

(d) Sketch the mild slope flow profiles (M1, M2 and M3) and prove that M2 profile was a drawdown curve.

(7 marks)

Q5 (a) Define:
i) Energy dissipator
ii) Vena contracta
iii) Sluice gate
iv) Sharp-crested weir

(4 marks)

(b) Briefly explain how to measure discharge, Q in a small drain.

(5 marks)

(c) Cippoletti weir with width of 1.7 m is constructed downstream of the channel. Predict the discharge Q, from the weir if the water is discharging under a head of 1.5 m with $C_c = 0.622$ and $C_v = 0.982$.

(5 marks)

(d) An underflow sluice gate was built to control water level as well as to prevent the intrusion of sea water. The channel is rectangular with bottom width, b = 2.3 m. The velocity below the sluice gate and the upstream water depth are 5.0 m/s and 1.7 m, respectively. Calculate the discharge if the height of gate opening is 0.5 m, the downstream flow depth is 1.4 m and the coefficient of discharge, C_d is 0.598.

(6 marks)

Q6 (a) Name **THREE (3)** types of pumps and **THREE (3)** types of turbines and briefly describes the function of pumps and turbines.

(5 marks)

(b) Using the aid of sketches, explain the concept of series and parallel pump.

(6 marks)

(c) A centrifugal pump discharges 0.02 m^3/s against a head of 16 m when the speed is 1500 rpm. The diameter of the impeller is 0.4 m and the brake power is 5 kW. A geometrically similar pump 0.45 m in diameter is to run at 1750 rpm. Assuming equal efficiencies, calculate

(i) The head developed, H
(ii) The amount of water pumped, Q
(iii) The brake power developed, P

(9 marks)

- END OF QUESTION -

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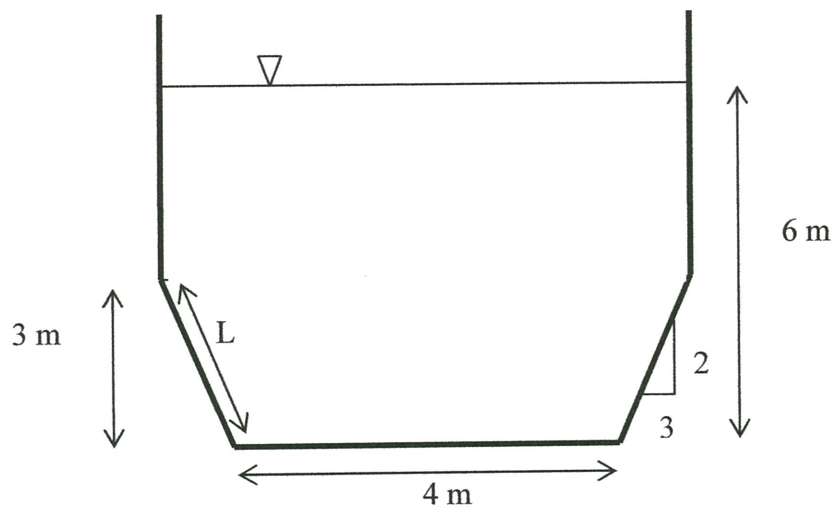

FIGURE Q1(a)

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EQUATIONS

$$A = \frac{D^2}{8}(\theta - \sin\theta) \qquad P = r\theta \qquad T = 2\sqrt{y(D-y)} \qquad Fr = \frac{v}{\sqrt{gD}}$$

$$Q = \frac{1}{n} AR^{2/3}\sqrt{S_o} \qquad \frac{y_2}{y_1} = \frac{1}{2}\left(-1+\sqrt{1+8Fr_1^2}\right) \qquad E_0 = y_0 + \frac{V^2}{2g}$$

$$K = \frac{1}{n} AR^{2/3} \qquad q = \frac{1}{n} y_0 R^{\frac{2}{3}} S_0^{\frac{1}{2}} \qquad y_c = \left(\frac{q^2}{g}\right)^{\frac{1}{3}} \qquad E_{\min} = 1.5 y_c \qquad i = \frac{n^2 v^2}{R^{4/3}}$$

$$h_l = \frac{(y_2 - y_1)^3}{4 y_1 y_2} \qquad P_l = \rho g Q E_l \qquad H_{\min} = E_0 - E_{\min}$$

$$dx = \frac{\left(y_2 + \left(\frac{v_2^2}{2g}\right)\right) - \left(y_1 + \left(\frac{v_1^2}{2g}\right)\right)}{S_o - S_{ave}} \qquad F_{r1} = \frac{V}{\sqrt{g y_1}} \qquad dx = \frac{dy}{S_o}\left[\frac{1 - \left(\frac{y_c}{y_{ave}}\right)^3}{1 - \left(\frac{K_o}{K_{ave}}\right)^{10/3}}\right]$$

$$Q = \frac{2}{3} C_d \sqrt{2g} L H_1^{3/2} \qquad C_d = 0.611 + 0.075\left(\frac{H_1}{P}\right) \qquad K = \frac{1}{n} AR^{2/3}$$

$$Q = \frac{8}{15} C_d \sqrt{2g}\tan\theta\, H_1^{5/2} \qquad Q = \frac{2}{3} C_d B \sqrt{2g}\, L_e H_1^{3/2} \qquad Q = baC_d\sqrt{2g(y_0 - y_1)}$$

$$L_e = L - (0.1 n H_1)$$

$$\left(\frac{H}{N^2 D^2}\right)_M = \left(\frac{H}{N^2 D^2}\right)_P \qquad \left(\frac{Q}{ND^3}\right)_M = \left(\frac{Q}{ND^3}\right)_P \qquad \left(\frac{P}{N^3 D^5}\right)_M = \left(\frac{P}{N^3 D^5}\right)_P$$

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TABLES

Table Q1

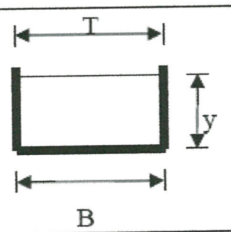
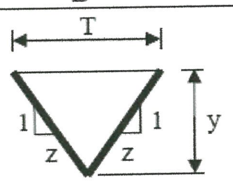
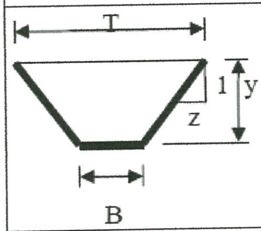
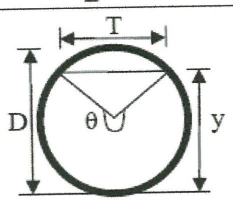
Bentuk	A	T	P
	By	B	B + 2y
	zy^2	2zy	$2y\sqrt{1+z^2}$
	$By + zy^2$	B + 2zy	$B + 2y\sqrt{1+z^2}$
	$\frac{D^2}{8}(\theta - \sin\theta)$ θ dalam radian	$D(\sin\frac{\theta}{2})$ atau $2\sqrt{y(D-y)}$	$\frac{\theta D}{2}$ θ dalam radian

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TABLE

Table Q2

Channel type	**Manning, *n* value**
Natural channel :-	
i) Clean and Straight	0.030
ii) Vegetation	0.100
iii) Mountain River	0.040 – 0.050
Artificial Channel :-	
i) Earth ground (clean)	0.022
ii) Earth ground (vegetation)	0.027 – 0.035
iii) Cement (plane / smooth)	0.011
iv) Cement (mortar)	0.013
v) Concrete	0.017
vi) Aspalt (smooth)	0.013
vii) Aspalt (rough)	0.016
viii) Steel	0.012