UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	HYDRAULICS
COURSE CODE	:	BFC 21103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	1.	ANSWER ALL QUESTIONS
	2.	THIS FINAL EXAMINATION IS AN **ONLINE ASSESSMENT** AND CONDUCTED VIA **CLOSE BOOK.**
	3.	STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) List **TWO (2)** types of open channel.

(2 marks)

(b) Both viscous and gravitational forces affect flow regime of an open channel. Briefly explain how these two forces play important roles in open channel flow.

(5 marks)

(c) A 8.0 m wide × 3.2 m high rectangular channel carries flow at depth of 3.0 m.

(i) Determine top width, cross sectional area, wetted perimeter and hydraulic radius of the flow.

(4 marks)

(ii) Estimate cost to excavate the channel if length of channel is 200 m and price rate of excavation is RM 10/m^3.

(3 marks)

(d) **FIGURE Q1(d)** shows a compound channel section with bottom slope of 0.0040 and side slope of 1 (horizontal) : 2 (vertical). If rate of flow is 25 m^3/s, determine

(i) Chezy's coefficient

(ii) Velocity of flow

(iii) State of flow based on Froude number

(11 marks)

Q2 (a) With aid of sketch, define specific energy curve.

(2 marks)

(b) Water flows in a compound channel shown in **FIGURE Q2(b)** at rate of 12 m^3/s. The channel has a span of 6666.67 m with elevation difference of 10 m. If Chezy coefficient is 62 $m^{0.5}$/s, propose dimensions for most hydraulically-efficient section for the channel.

(7 marks)

(c) A trapezoidal channel with bottom width 3 m and side slopes 5(H) : 2(V) conveys 8 m^3/s of flow. The channel rests on 0.32° ground surface lined with concrete at bottom and dressed stone in mortar on both sides (**TABLE Q2(c)**). If a 0.5 m-high weir is placed across the channel section, determine depth of flow above the weir.

(8 marks)

(d) If scenario in Question **Q2(c)** is added with constricted width of 3.5 m at surface of the channel,

(i) Predict depths of flow that will occur before, on and after the constriction.

(6 marks)

(ii) Sketch all the conditions obtained from Questions **Q2(c)** and **Q2(d)(i)** in plan and elevation views.

(2 marks)

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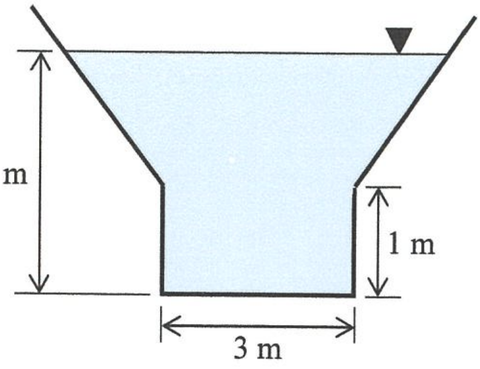

FIGURE Q1(d)

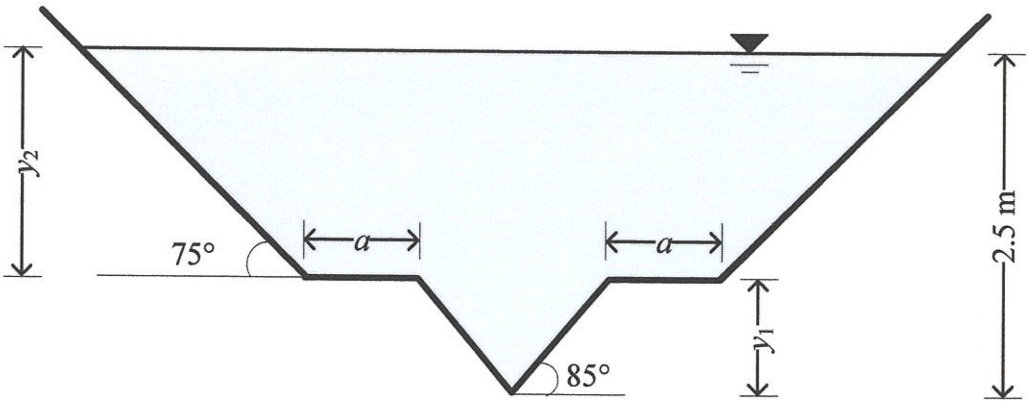

FIGURE Q2(b)

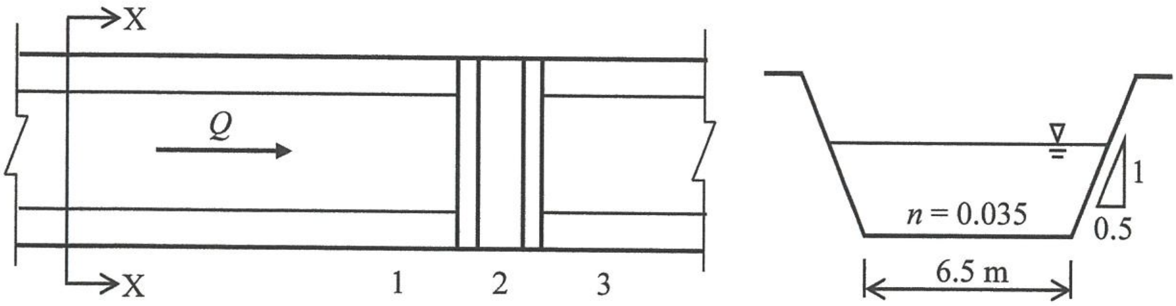

FIGURE Q3

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TABLE 1

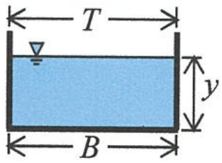
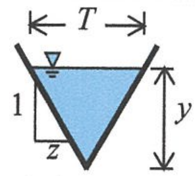
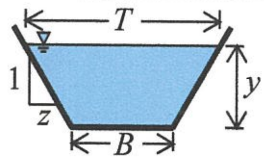
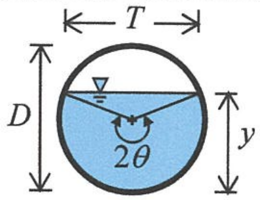
Section	Flow area A	Top width T	Wetted perimeter P
 Rectangular	By	B	$B+2y$
 Triangular	zy^2	$2zy$	$2y\sqrt{1+z^2}$
 Trapezoidal	$By+zy^2$	$B+2zy$	$B+2y\sqrt{1+z^2}$
 Circular	$\frac{D^2}{8}(2\theta-\sin 2\theta)$	$D\sin\theta$	θD

TABLE Q2(b)

Cross section	Flow area A	Wetted perimeter P	Hydraulic radius R	Top width T	Hydraulic depth D
Trapezoid	$\sqrt{3}y^2$	$2\sqrt{3}y$	$\frac{y}{2}$	$\frac{4\sqrt{3}}{3}y$	$\frac{3}{4}y$
Rectangle	$2y^2$	$4y$	$\frac{y}{2}$	$2y$	y
Triangle	y^2	$2\sqrt{2}y$	$\frac{\sqrt{2}}{4}y$	$2y$	$\frac{y}{2}$
Semicircle	$\frac{\pi}{2}y^2$	πy	$\frac{y}{2}$	$2y$	$\frac{\pi}{4}y$
Parabola	$\frac{4\sqrt{2}}{3}y^2$	$\frac{8\sqrt{2}}{3}y$	$\frac{y}{2}$	$2\sqrt{2}y$	$\frac{2}{3}y$

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TABLE Q2(c)

Channel type	Manning's *n*
Concrete	
i. formed, no finish	0.013 - 0.017
ii. float finish	0.013 - 0.015
iii. gunite, wavy section	0.018 - 0.022
Concrete bottom, float finish, sides as indicated	
i. random stone in mortar	0.017 - 0.020
ii. cement rubble masonry, plastered	0.016 - 0.020
iii. dressed stone in mortar	0.015 - 0.017
iv. cement rubble masonry	0.020 - 0.025
v. dry rubble (rip-rap)	0.020 - 0.030
Metal	
i. smooth steel surface (unpainted)	0.011 - 0.014
ii. corrugated	0.021 - 0.030
Brick	
i. glazed	0.011 - 0.015
ii. in cement mortar	0.012 - 0.018
Wood	
i. planed, untreated	0.010 - 0.014
ii. plank with battens	0.012 - 0.018

TABLE Q4 (d)

Parameter	Inlet section	Outlet section
Gage pressure p (kPa)	74.7	553.1
Elevation above datum z (m)	2.49	4.36
Velocity of flow V (m/s)	3.13	5.23

TABLE Q4

Temperature T (°C)	Density ρ (kg/m^3)	Specific weight γ (N/m^3)	Dynamic viscosity μ (Ns/m^2)	Surface tension* σ (N/m)
0	1000	9810	1.75×10^{-3}	0.0756
10	1000	9810	1.30×10^{-3}	0.0742
20	998	9790	1.02×10^{-3}	0.0728
30	996	9770	8.00×10^{-4}	0.0712
40	992	9730	6.51×10^{-4}	0.0696
50	988	9690	5.41×10^{-4}	0.0679
60	984	9650	4.60×10^{-4}	0.0662
70	978	9590	4.02×10^{-4}	0.0644
80	971	9530	3.50×10^{-4}	0.0626
90	965	9470	3.11×10^{-4}	0.0608
100	958	9400	2.82×10^{-4}	0.0589

**In contact with air*

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Equations sheet

$Q = AV$ $q = yV$ $Q = \frac{1}{n}AR^{\frac{2}{3}}S_o^{\frac{1}{2}}$ $Q = ACR^{\frac{1}{2}}S_o^{\frac{1}{2}}$

$R = \frac{A}{P}$ $D = \frac{A}{T}$ $\frac{A_c^3}{T_c} = \frac{Q^2}{g}$ $y_c = \sqrt[3]{\frac{q^2}{g}}$

$\text{Fr} = \frac{V}{\sqrt{gD}}$ $\text{Re} = \frac{VR}{v}$ $S_c = \frac{n^2 g A_c}{T_c R_c^{\frac{4}{3}}}$ $E_{\min} = \frac{3}{2}y_c$

$E = y + \frac{Q^2}{2gA^2}$ $E = y + \frac{q^2}{2gy^2}$ $A = \left(2\sqrt{1+z^2} - z\right)y^2$

$E_o = E_2 + H_2$ $E_o = E_{\min} + H_{\min}$ $E'_{1,3} = E_{\min} + H_2$

$\frac{y_2}{y_1} = \frac{1}{2}\left(-1 + \sqrt{1 + 8\text{Fr}_1^2}\right)$ $E_L = \frac{(y_2 - y_1)^3}{4y_1y_2}$ $P_L = \rho g Q E_L$

$V_1 = \sqrt{2g\left(H_1 - \frac{H_o}{2}\right)}$ $P = \gamma QH$ $P = \frac{2\pi N}{60}T$ $H = \frac{p}{\gamma} + z + \frac{V^2}{2g}$

$\eta = \frac{P_o}{P_i}$ $L_2 = 0.8y_2$ $\text{No. of blocks} = \frac{B}{(s+w)}$

Block A	Block B	Block C
$h_1 = y_1$ $s_1 = y_1$ $w_1 = y_1$	$h_3 = (0.168\text{Fr}_1 + 0.63)y_1$ $s_3 = 0.75h_3$ $w_3 = 0.75h_3$ $t_3 = 0.2h_3$ $z_3 = 1.0$	$h_4 = \left(\frac{\text{Fr}_1}{18} + 1\right)y_1$ $z_4 = 2.0$