SULIT

KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI II : 2023/2024

DCC50222 : HYDRAULICS

TARIKH : 05 JUN 2024
MASA : 2.30 PETANG - 4.30 PETANG

Kertas ini mengandungi **SEBELAS (11)** halaman bercetak.
Bahagian A: Subjektif (2 soalan)
Bahagian B: Subjektif (4 soalan)
Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SECTION A : 50 MARKS
BAHAGIAN A : 50 MARKAH

INSTRUCTION:
This section consists of **TWO (2)** subjective questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **DUA (2)** soalan subjektif. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO1 (a) In a rectangular tank contains water. When a surface is submerged in water, force action on the surface, bottom and ends of the tank. Illustrate the pressure on the bottom and the ends of the tank.
Dalam tangki berbentuk segiempat tepat mengandungi air. Apabila permukaan terendam dalam air, daya bertindak pada permukaan, bawah dan hujung tangki. Lakarkan tekanan pada bawah dan hujung tangki.

[4 marks]
[*4 markah*]

CLO1 (b) A rectangular plate Figure A1(b) with a width of 2 m and a depth of 3.5 m is held vertically in water at 3.35 m below the surface of the free water. Identify the hydrostatic force at one surface of the plate, and the depth of center pressure. Given the Specific Weight of water is 9.81 kN/m^3.
Sebuah plat berbentuk segiempat tepat Rajah A1(b) dengan lebar 2 m dan dalam 3.5 m dipegang secara menegak di dalam air dengan jarak 3.35 *m di bawah permukaan air bebas. Kenal pasti daya hidrostatik pada satu permukaan plat, dan kedalaman pusat tekanan. Diberi Berat Tentu air adalah 9.81 kN/m^3.*

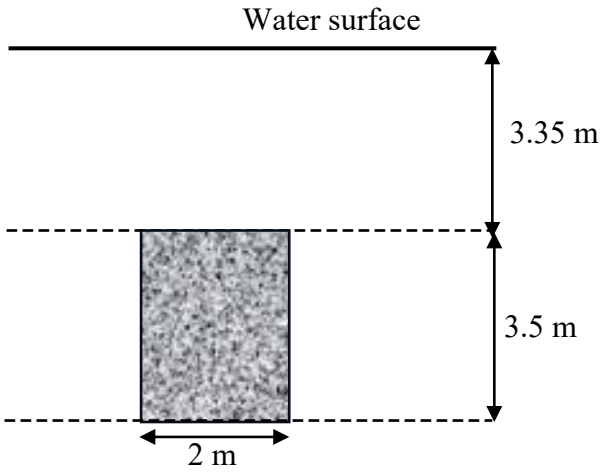


Figure A1(b) / *Rajah A1(b)*

[6 marks]

[*6 markah*]

CLO1 (c) Given the Specific Gravity of fluid is 1.2 to the curved blade as shown in Figure A1(c). The curved blade radius is 2.1 m and 5.2 m long. The upper edge of the curved blade from the fluid surface is 3.8 m. Determine the magnitude and direction of the resultant force.

Diberi Graviti Tentu bendalir adalah 1.2 kepada bilah melengkung seperti ditunjukkan dalam Rajah A1(c). Jejari bilah melengkung adalah 2.1 m dan 5.2 m panjang. Jarak bahagian atas bilah melengkung dari permukaan bendalir adalah 3.8 m. Tentukan magnitud dan arah daya paduan.

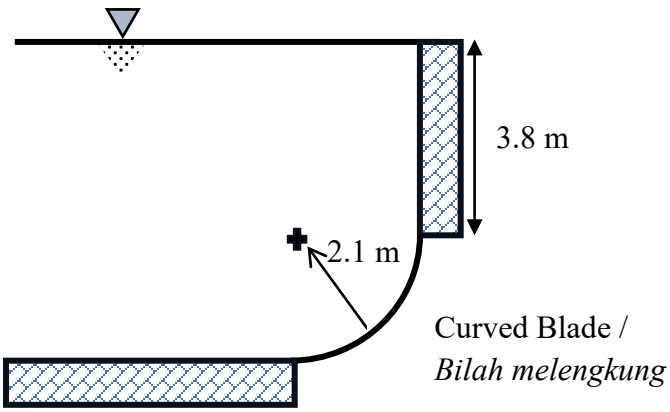


Figure A1(c) / *Rajah A1(c)*

[15 marks]

[*15 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) Stability of floating body occurs when the body undergoes an angular displacement at a horizontal axis. The shape of the immersed volume changes and the center of buoyancy moves relatively with the body. Explain the neutral equilibrium of floating body with the aid of a diagram.

Kestabilan jasad terapung berlaku apabila jasad mengalami anjakan sudut pada paksi mendatar. Bentuk isipadu yang tenggelam berubah dan pusat daya keapungan bergerak secara relatif dengan jasad. Terangkan keseimbangan neutral bagi jasad terapung dengan bantuan gambarajah.

[4 marks]

[*4 markah*]

CLO1 (b) A cylinder object with a diameter of 2.0 m and a height of 1.5 m has a weight in the air at 3500 N. The object is immersed in water and has a weight at 2000 N. If the object is in equilibrium, identify the volume of water displaced and the height of the immersed object.

Sebuah objek silinder dengan diameter 2.0 m dan tinggi 1.5 m mempunyai berat di udara 3500 N. Objek tersebut telah direndam dalam air dan mempunyai berat 2000 N. Jika objek berada dalam keseimbangan, kenal pasti isipadu air yang disesarkan dan ketinggian objek yang direndam.

[6 marks]

[*6 markah*]

CLO1

(c) A wooden cube sized 0.7 m floating in the water as shown in Figure A2(c). Determine the meta centric height and equilibrium of the wooden cube.

Sebuah kiub kayu bersaiz 0.7 m terapung dalam air seperti yang ditunjukkan di dalam Rajah A2(c). Tentukan ketinggian pusat meta dan keseimbangan kiub kayu tersebut.

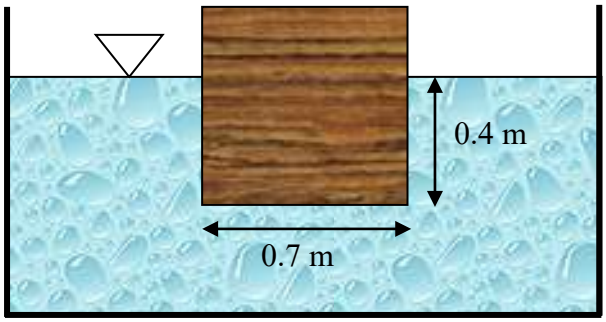


Figure A2(c) / *Rajah A2(c)*

[15 marks]

[*15 markah*]

SECTION B : 50 MARKS
BAHAGIAN B : 50 MARKAH

INSTRUCTION:
This section consists of **FOUR (4)** subjective questions. Answer **TWO (2)** questions only.

ARAHAN:
*Bahagian ini mengandungi **EMPAT (4)** soalan subjektif. Jawab **DUA (2)** soalan sahaja.*

QUESTION 1
SOALAN 1

CLO2 (a) With the aid of a diagram, explain uniform flow in open channel.
Dengan bantuan gambarajah, terangkan aliran seragam dalam saluran terbuka.

[4 marks]
[*4 markah*]

CLO2 (b) Based on Figure B1(b) below, calculate the best hydraulic cross-section for rectangular channel to convey 12.5 m^3/s discharge with Manning coefficient of 0.03 and bed slope of the channel is 0.0005.
Berdasarkan Rajah B1(b) dibawah, kirakan keratas rentas terbaik hidraulik bagi saluran berbentuk segiempat yang membawa kadaralir 12.5 m^3/s dengan pekali Manning 0.03 dan kecerunan dasar 0.0005.

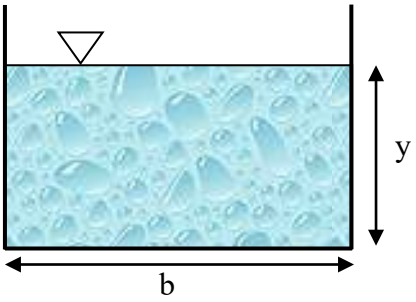


Figure B1(b) / *Rajah B1(b)*

[9 marks]

[*9 markah*]

CLO 2

(c) An open trapezoidal channel with side slope 1:2, bed slope 1:4000 and the water depth is 3.26 m. By using Manning coefficient, n = 0.058, calculate discharge in m^3/s in as shown in Figure B1(c).

Sebuah saluran terbuka berbentuk trapezoid mempunyai kecerunan sisi 1:2, kecerunan dasar saluran ini adalah 1:4000 dan kedalaman air adalah 3.26 *m. Dengan menggunakan pekali Manning, n=* 0.058*, kirakan kadaralir dalam* m^3/s *seperti Rajah B1(c).*

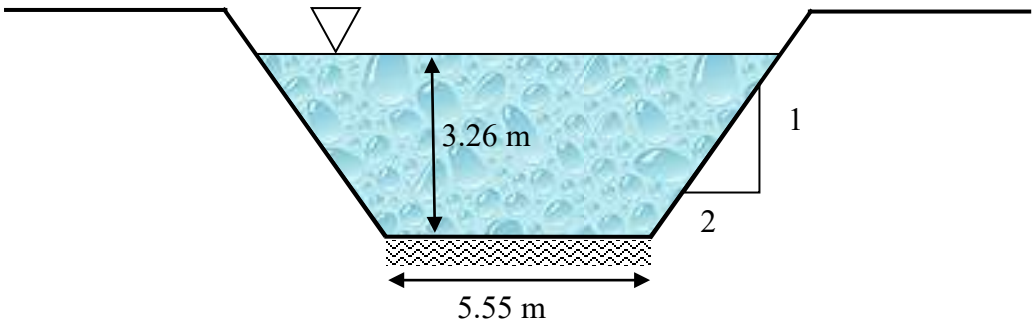


Figure B1(c) / *Rajah B1(c)*

[12 marks]

[*12 markah*]

QUESTION 2

SOALAN 2

CLO2 (a) Explain the term of hydraulic gradient.

Terangkan istilah kecerunan hidraulik.

[4 marks]

[*4 markah*]

CLO2 (b) A cement-lined rectangular channel of 5 m wide carries water at the rate of 30 m^3/s as shown in Figure 2(b). Calculate the value of Manning's coefficient, if the bed slope required to maintain a depth of 1.5 m is 1/725.

Saluran berlapik simen berbentuk segiempat tepat selebar 5 m membawa air pada kadar 30 m^3/s seperti Rajah B2(b). Kirakan nilai pekali Manning, jika keperluan kecerunan dasar untuk mengekalkan kedalaman 1.5 m adalah 1/725.

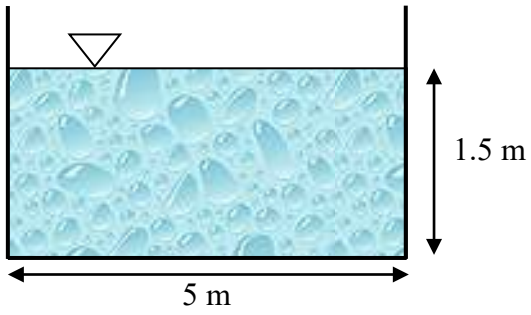


Figure B2(b) / *Rajah B2(b)*

[9 marks]

[*9 markah*]

CLO2 (c) One of the advantages of a trapezoidal channel is it has maximum discharge. A trapezoidal channel has a 1V:2H side slope and bed slope 1 in 2000. The area of the section is 48 m^2. Determine the dimension of the channel for Figure B2(c) and the discharge of the channels for the most economical section if Manning's coefficient = 0.017.

Salah satu kelebihan saluran berbentuk trapezoid ialah ia mempunyai kadaralir maksimum. Saluran trapezoid mempunyai 1V:2H kecerunan sisi dan kecerunan dasar 1 dalam 2000. Luas bahagian adalah 48 m^2 . Tentukan dimensi saluran bagi Rajah B2(c) dan kadaralir bagi keratan paling ekonomikal jika pekali Manning = 0.017.

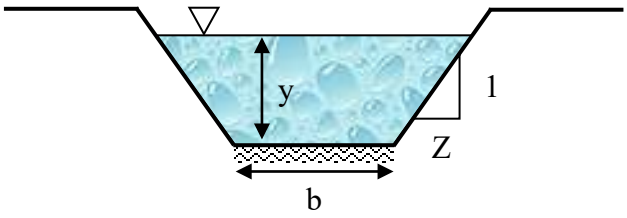


Figure B2(c) / *Rajah B2*(c)

[12 marks]

[*12 markah*]

QUESTION 3

SOALAN 3

CLO2 (a) The velocity of flow at critical depth is known is critical flow. Identify types of flow based on the critical depth flow condition with the aid of a diagram.

Halaju aliran pada kedalaman kritikal dikenali sebagai aliran kritikal. Kenal pasti jenis aliran berdasarkan keadaan aliran kedalaman kritikal dengan bantuan gambarajah.

[4 marks]

[*4 markah*]

CLO2 (b) A flow rate of water through an open rectangular channel is 30 m^3/s. Given the width of channel and depth of water are 10 m and 1 m. Determine specific energy, Froude number and types of flow.

Kadaralir bagi air yang melalui saliran berbentuk segiempat tepat terbuka adalah 30 m^3/s. Diberikan lebar saliran dan kedalaman air adalah 10 m dan 1 m. Tentukan tenaga tentu, nombor Froud dan jenis aliran.

[9 marks]

[*9 markah*]

CLO2 (c) An open rectangular channel with 6 m wide flowing water at rate of 18 m^3/s. Given the Manning's coefficient is 0.012. Determine critical depth, critical velocity, minimum specific energy, and hydraulic gradient at critical depth.

Sebuah saliran berbentuk segiempat tepat terbuka dengan lebar 6 m mengalirkan air pada kadaralir 18 m^3/s. Diberikan pekali Manning adalah 0.012. Tentukan kedalaman kritikal, halaju kritikal, tenaga tentu minimum dan kecerunan hidraulik pada kedalaman kritikal.

[12 marks]

[*12 markah*]

QUESTION 4

SOALAN 4

CLO2 (a) The critical depth and critical velocity are parameters for non-uniform flow. Identify the terms of the two parameters.

Kedalaman kritikal dan halaju kritikal adalah parameter untuk aliran tidak seragam. Kenal pasti istilah bagi dua parameter tersebut.

[4 marks]

[*4 markah*]

CLO2 (b) A hydraulic jump occurs in a 3.1 m wide rectangular channel, flow depth before the jump 0.62 m. Discharge in the channel is 12.5 m^3/s. Determine flow depth after the jump, type of jump, energy loss and power due to jump.

Lompatan hidraulik berlaku dalam saluran segi empat tepat selebar 3.1 m, kedalaman aliran sebelum lompatan 0.62 m. Kadar alir dalam saluran ialah 12.5 m^3/s. Tentukan kedalaman aliran selepas lompatan, jenis lompatan, kehilangan tenaga dan kuasa berdasarkan lompatan.

[9 marks]

[*9 markah*]

CLO2 (c) Water flows at the rate of 1 m^3/s along a channel of rectangular section of 1.5 m width. If a hydraulic jump occurs at a point where upstream depth is 350 mm. Calculate the increase value in water level after the hydraulic jump and energy loss of water.

Air mengalir pada kadar 1 m^3/s di sepanjang saluran keratan segi empat tepat dengan lebar 1.5 m. Jika lompatan hidraulik berlaku pada titik di mana kedalaman hulu 350 mm. Kirakan nilai peningkatan aras air selepas lompatan hidraulik dan kehilangan tenaga air.

[12 marks]

[*12 markah*]

SOALAN TAMAT

FORMULA DCC50222: HYDRAULICS

HYDROSTATIC FORCE

$$F_R = \rho g h_{cg} A$$

$$h_{cp} = \frac{I_c \sin^2\theta}{A\, h_{cg}} + h_{cg}$$

$$F_H = \rho g h_{cg} A$$

$$F_V = \rho g V$$

$$F_R = \sqrt{(F_H)^2 + (F_V)^2}$$

$$\alpha = \tan^{-1}\left(\frac{F_V}{F_H}\right)$$

$$h_{cp} = \frac{F_1\left(\frac{2}{3}h_1\right) - F_2\left(\frac{2}{3}h_2\right)}{F_R}$$

$$F_1 = \frac{1}{2}(\rho_1 g h_1) h_1 L$$

$$F_2 = (\rho_1 g h_1) h_2 L$$

$$F_3 = \frac{1}{2}(\rho_2 g h_2) h_2 L$$

$$F_R = F_1 + F_2 + F_3$$

$$F_R = F_1 - F_2$$

$$h_{cp} = \frac{2}{3}H$$

$$h_{cp} = \frac{F_1\left(\frac{2}{3}h_1\right) + F_2\left(\frac{h_2}{2} + h_1\right) + F_3\left(\frac{2}{3}h_2 + h_1\right)}{F_R}$$

BUOYANCY AND FLOATATION

$$W = \rho_b g V_b$$

$$F_B = \rho_f g V_d$$

$$BG = OG - OB$$

$$BM = \frac{I_C}{V_d}$$

$$GM = BM - BG$$

UNIFORM OPEN CHANNEL

$$Q = Av$$

$$v = \frac{R^{\left(\frac{2}{3}\right)} S_o^{\left(\frac{1}{2}\right)}}{n}$$

$$Q = \frac{AR^{\left(\frac{2}{3}\right)} S_O^{\left(\frac{1}{2}\right)}}{n}$$

$$R = \frac{A}{P}$$

Best hydraulics cross section

Rectangular

$$b = 2y$$

Trapezoidal

$$b + 2zy = 2y\sqrt{1 + z^2}$$

Circular

$$r = y$$

NON-UNIFORM OPEN CHANNEL

$$E = y + \left[\frac{v^2}{2g}\right]$$

$$E = y + \left[\frac{Q^2}{2gA^2}\right]$$

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

$$y_1 = \frac{y_2}{2}\left[\sqrt{1 + (8{Fr_2}^2)} - 1\right]$$

$$y_2 = \frac{y_1}{2}\left[\sqrt{1 + (8{Fr_1}^2)} - 1\right]$$

$$\Delta y = y_2 - y_1$$

$$v_c = \sqrt{g\, y_c}$$

$$y_c = \left[\frac{Q^2}{b^2 g}\right]^{\frac{1}{3}}$$

$$y_c = \left[\frac{q^2}{g}\right]^{\frac{1}{3}}$$

$$E_{min} = \frac{3}{2}\, y_c$$

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

$$P = \rho Q g E_L$$

Table A1: *Geometric Properties of Plane Surface*

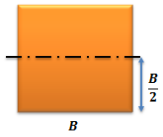
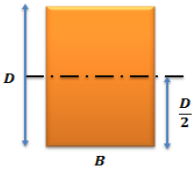
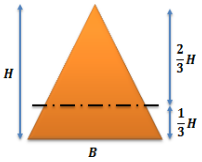
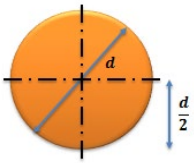
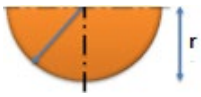
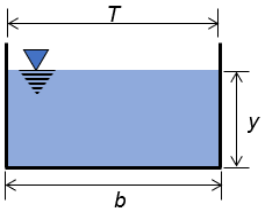
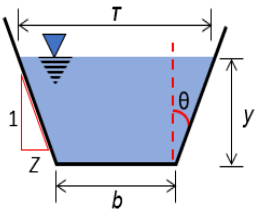
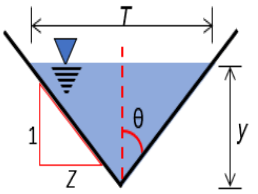
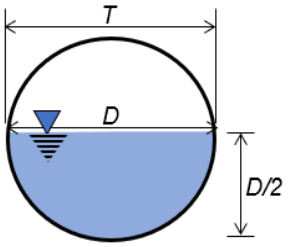
	Square	Rectangle	Triangle	Circle	Semi-circle
Shape					
Area	$A = B^2$	$A = BD$	$A = \frac{1}{2} BH$	$A = \frac{\pi d^2}{4}$	$A = \frac{\pi r^2}{2}$
I_c	$I_c = \frac{B^4}{12}$	$I_c = \frac{BD^3}{12}$	$I_c = \frac{BH^3}{36}$	$I_c = \frac{\pi d^4}{64}$	$I_c = 0.1102r^4$

Table A2: *Geometric Properties of Open Channel Cross-section*

Section	Area, A (m^2)	Wetted Perimeter, P (m)	Top Width, T (m)
Rectangular 	$A = by$	$P = b + 2y$	$T = b$
Trapezoidal 	$A = y(b + zy)$ @ $A = y[b + (\tan\theta)y]$	$P = b + 2y\sqrt{1 + z^2}$ @ $P = b + \frac{2y}{\cos\theta}$	$T = b + 2zy$ @ $T = b + 2(\tan\theta)y$
Triangular 	$A = y(zy)$ @ $A = y[(\tan\theta)y]$	$P = 2y\sqrt{1 + z^2}$ @ $P = \frac{2y}{\cos\theta}$	$T = 2zy$ @ $T = 2(\tan\theta)y$
Semi-circular 	$A = \frac{\pi r^2}{2}$ @ $A = \frac{\pi D^2}{8}$	$P = \pi r$ @ $P = \frac{\pi D}{2}$	$T = D$