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 I : 2024/2025

DCC50222 : HYDRAULICS

TARIKH : 10 DISEMBER 2024
MASA : 11.30 PAGI – 1.30 PETANG (2 JAM)

Kertas ini mengandungi **DUA BELAS (12)** 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) Figure A1(a) shows a circular plate of 3.5 m diameter which is placed vertically in water. The center of the plate is 3.3 m below the free surface. Identify the total hydrostatic forces on the plate.

Rajah A1(a) menunjukkan plat berbentuk bulat dengan 3.5 m diameter diletakkan secara menegak di dalam air. Bahagian tengah plat adalah 3.3 m di bawah permukaan bebas. Kenal pasti jumlah daya hidrostatik di atas plat.

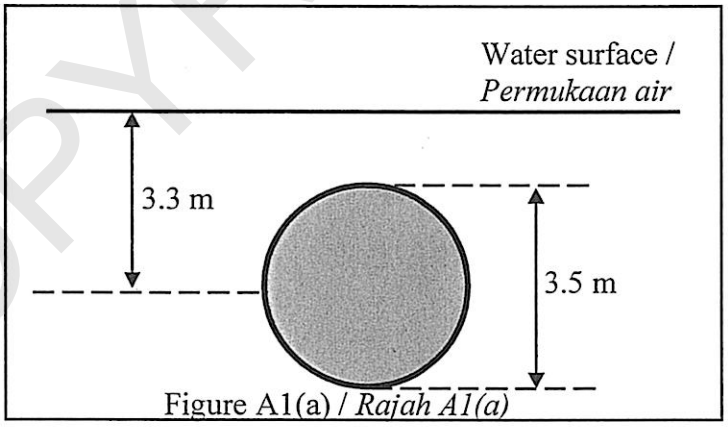


Figure A1(a) / *Rajah A1(a)*

[4 marks]

[*4 markah*]

CLO1 (b) A triangular plate of 0.5 m base and 2 m height is immersed vertically in water as shown in Figure A1(b). Identify the hydrostatic force acting on the plate.
Sekeping plat berbentuk segitiga dengan ukuran 0.5 m pada tapak dan tinggi 2 m, tenggelam secara menegak di dalam air seperti Rajah A1(b). Kenal pasti daya hidrostatik yang bertindak ke atas plat tersebut.

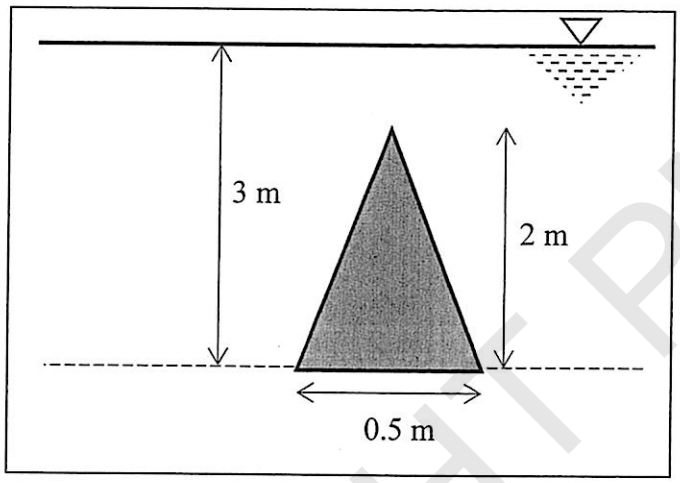


Figure A1(b) / *Rajah A1(b)*

[6 marks]
[*6 markah*]

CLO1 (c) An inclined rectangular water gate with 1.5 m height and 2 m width is immersed as shown in Figure A1(c). The water gate is placed 2 m below the water surface. Calculate the total hydrostatics force acting on the gate and position of the centre of pressure.

Pintu air segi empat tepat cenderung, ketinggian 1.5 m dan lebar 2 m direndam seperti yang ditunjukkan dalam Rajah A1(c). Pintu air diletakkan 2 m di bawah permukaan air. Kirakan jumlah daya hidrostatik yang bertindak di pintu dan kedudukan pusat tekanan.

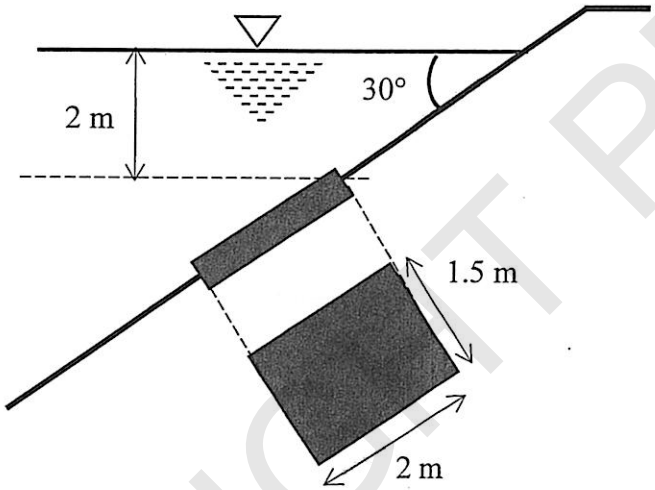


Figure A1(c) / *Rajah A1(c)*

[15 marks]

[*15 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) Whenever a body floating in a liquid is given small angular displacement, it will oscillating to a point which is called metacenter. Explain **TWO (2)** types of equilibrium of floating body with respect to metacenter of the floating body.
*Apabila jasad terapung dalam cecair diberi sedikit anjakan, jasad tersebut akan berayun ke satu titik kedudukan yang dikenali sebagai pusat meta. Terangkan **DUA (2)** jenis keseimbangan jasad terapung berdasarkan kedudukan pusat meta bagi jasad terapung.*

[4 marks]
[*4 markah*]

CLO1 (b) A block of wood (density = 600 kg/m^3) with a dimension of 10 cm × 5 cm × 3 cm is slowly released into a tank of water (density = 1000 kg/m^3). Identify the block of wood that will float or sink with relevance justification and volume of water displaced.
Sebuah blok kayu (ketumpatan = 600 kg/m^3) berdimensi 10 cm × 5 cm × 3 cm dilepaskan secara perlahan ke dalam aipr (ketumpatan = 1000 kg/m^3). Kenal pasti bongkah kayu yang akan terapung atau tenggelam dengan justifikasi berkaitan dan isipadu air yang disesarkan.

[6 marks]
[*6 markah*]

CLO1

(c) A pontoon measuring 20 m × 10 m × 5 m with a mass of 100 tonne is designed to carry vehicles from the ship to the port. The weight of a vehicle is 2000 kg. This pontoon can carry a maximum of 20 vehicles for one load. Determine the stability of this pontoon when the load is full if the density of the sea water is 1200 kg/m^3.

Sebuah pontun berukuran 20m × 10m × 5m berjisim 100 tan direkabentuk untuk membawa kenderaan dari kapal ke pelabuhan. Berat sebuah kenderaan tersebut ialah 2000kg. Ponton ini boleh membawa maksimum sebanyak 20 kenderaan untuk satu muatan. Tentukan kestabilan ponton ini apabila muatan penuh, jika ketumpatan air laut 1200kg/m^3.

[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) The base width of a most economical rectangular channel is 10 m. Identify the hydraulic radius of the channel.

Lebar saluran berbentuk segiempat yang paling ekonomi ialah 10 m. Kenal pasti jejari hidraulik saluran tersebut.

[4 marks]

[*4 markah*]

CLO2 (b) A flow rate of 9.6 m^3/s flows in an open channel at a velocity of 6.0 m/s. The channel cross-section is trapezoidal Figure B1(b) with water depth equal to the width of the channel bottom and side slope of 1:1. Given the Manning's coefficient is 0.020. Determine the channel bottom width and the channel bed slope.

Kadar alir 9.6 m^3/s mengalir dalam saluran terbuka pada halaju 6.0m/s. Keratan rentas saluran adalah berbentuk trapezoid Rajah B1(b) dengan kedalaman air sama dengan lebar bahagian bawah saluran dan cerun sisi 1:1. Diberi pekali Manning ialah 0.020. Tentukan lebar bawah saluran dan kecerunan dasar saluran.

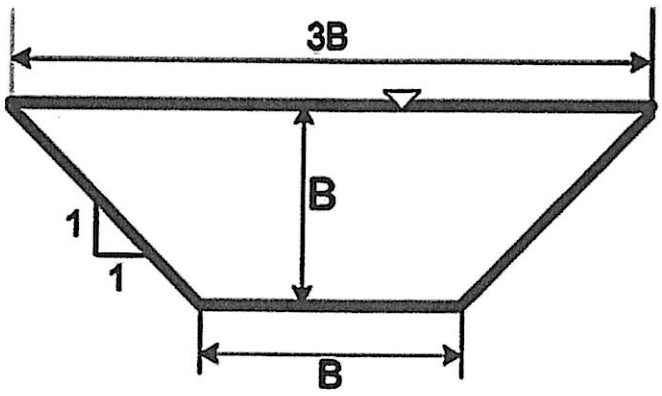


Figure B1(b) / *Rajah B1(b)*

[9 marks]
[*9 markah*]

CLO2 (c) A channel is designed to carry a discharge of 40 m^3/s with Manning's coefficient = 0.015 and bed slope of 1 in 1000. Calculate the channel dimensions of the most efficient section if the channel is rectangular.

Sebuah saluran direka bentuk untuk membawa kadaralir 40 m^3/s dengan pekali Manning = 0.015 dan kecerunan dasar 1 dalam 1000. Kirakan dimensi saluran bagi keratan terbaik jika saluran itu adalah berbentuk segiempat tepat.

[12 marks]
[*12 markah*]

QUESTION 2

SOALAN 2

CLO2 (a) Explain the term of wet perimeter with the aid of a diagram.
Terangkan istilah perimeter basah dengan bantuan gambarajah.

[4 marks]
[*4 markah*]

CLO2 (b) Water at the rate of 0.8 m^3/s flows through a 1 m diameter sewer, when the sewer pipe is half full as shown in Figure B2(b). Calculate the bed slope if Manning's coefficient is 0.013.
Air pada kadar 0.8 m^3/s mengalir melalui sebuah pembetung berdiameter 1 m, apabila paip pembetung separuh penuh seperti ditunjukkan dalam Rajah B2(b). Kirakan kecerunan dasar, jika pekali Manning ialah 0.013.

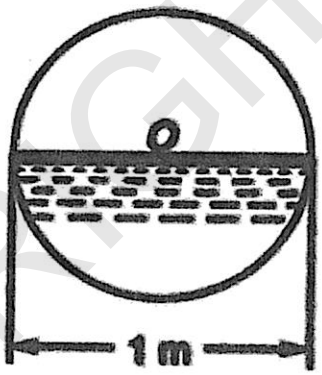


Figure B2(b) / *Rajah B2(b)*

[9 marks]
[*9 markah*]

CLO2 (c) Water will flow in a rectangular channel at a rate of 2.84 m^3/s and at a bed slope of 0.0028. Determine the channel width and water depth if the width must be equal to twice the water depth. Manning's coefficient can be taken as 0.017.
Air akan mengalir dalam saluran berbentuk segiempat tepat pada kadar 2.84m^3/s dan pada kecerunan dasar 0.0028. Tentukan lebar saluran dan kedalaman air jika lebar mestilah sama dengan dua kali ganda kedalaman air. Pekali Manning boleh diambil sebagai 0.017.

[12 marks]
[*12 markah*]

QUESTION 3

SOALAN 3

CLO2 (a) Hydraulic jump on a horizontal bottom can occur in several distinct forms based on the Froude number of supercritical flow. Distinguish **FOUR (4)** types of hydraulic jump based on the Froude number.

*Lompatan hidraulik bagi saluran mendatar boleh berlaku dalam beberapa bentuk yang berbeza berdasarkan kepada nombor Froude bagi aliran superkritikal. Bezakan **EMPAT (4)** jenis lompatan hidraulik berdasarkan nombor Froud.*

[4 marks]

[*4 markah*]

CLO2 (b) A sluice gate at Terusan Haji Salleh is opened to prevent upstream overflow after 1 hour of heavy rain. The width of the channel is 1.5 m and flows through the opened sluice gate 10 m/s with a depth of 65 cm. Based on the conditions calculate the height of the jump and type of hydraulic jump.

Pintu air di Terusan Haji Salleh dibuka untuk mengelakkan limpahan air di hulu selepas hujan lebat selama 1 jam. Lebar saluran ialah 1.5 m dan mengalir melalui pintu air yang dibuka 10 m/s dengan kedalaman 65 cm. Berdasarkan keadaan tersebut kirakan ketinggian lompatan hidraulik dan jenis lompatan hidraulik.

[9 marks]

[*9 markah*]

CLO2 (c) A discharge of 1000 L/s flows along a rectangular channel which is 1.5 m wide. If a hydraulic jump is to be formed at a point, where the upstream depth is 180 mm, determine the type of flow and energy is absorbed in the jump.

Kadaralir sebanyak 1000 L/s mengalir di sepanjang saluran segi empat tepat, lebar 1.5 m. Jika lompatan hidraulik dibentuk pada satu lokasi, di mana kedalaman hulu ialah 180 mm, tentukan jenis aliran dan tenaga yang diserap dalam lompatan ini.

[12 marks]

[*12 markah*]

QUESTION 4

SOALAN 4

CLO2 (a) Explain hydraulics jump with the aid of a diagram.

Terangkan lompatan hidraulik dengan bantuan gambarah.

[4 marks]

[*4 markah*]

CLO2 (b) Figure B4(b) shows a rectangular horizontal channel which is 2 m wide and carries a flow of 4 m^3/s. The water depth on the downstream side of the hydraulic jump is 1 m. Calculate the upstream depth and the loss of energy.

Rajah B4(b) menunjukkan saluran mendatar berbentuk segiempat tepat dengan 2 m lebar, membawa aliran 4 m^3/s. Kedalaman air di bahagian hilir, lompatan hidraulik ialah 1 m. Kirakan kedalaman hulu dan kehilangan tenaga.

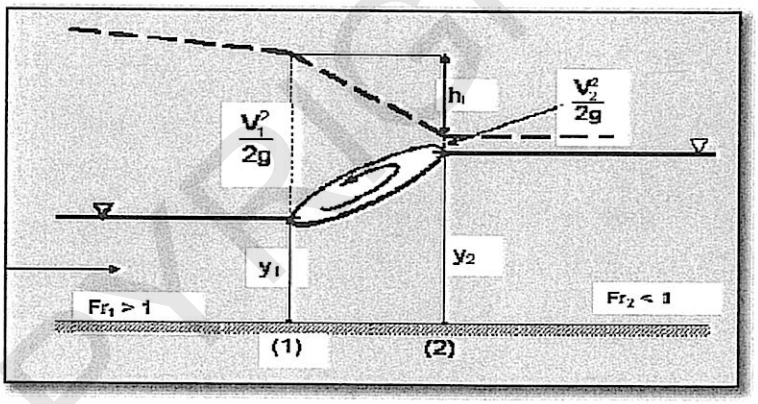


Figure B4(b) / *Rajah B4(b)*

[9 marks]

[*9 markah*]

CLO2 (c) Water is being discharged through a rectangular open channel with 1 m width, where a hydraulic jump occurs due to an obstruction at the downstream end of the channel. If the depth of flow before the hydraulic jump is 30 cm and the corresponding velocity is 16 m/s, determine depth of flow after the hydraulic jump, height of the hydraulic jump, specific energy loss due to the hydraulic jump and power loss due to the hydraulic jump.

Air mengalir melalui saluran terbuka segi empat tepat dengan 1 m lebar, di mana lompatan hidraulik berlaku disebabkan oleh halangan pada penghujung hulu saluran. Jika kedalaman aliran sebelum lompatan hidraulik ialah 30 cm dan halaju 16 m/s, tentukan kedalaman aliran selepas lompatan hidraulik, ketinggian lompatan hidraulik, kehilangan tenaga tertentu disebabkan oleh lompatan hidraulik dan kehilangan kuasa akibat lompatan hidraulik.

[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

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

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

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

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

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

$$\Delta y = y_2 - y_1$$

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

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

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

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

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

$$P = \rho Q g E_L$$

Table A1: *Geometric Properties of Plane Surface*

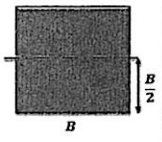
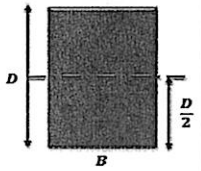
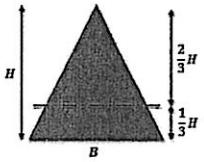
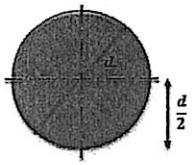
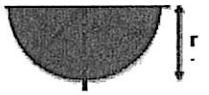
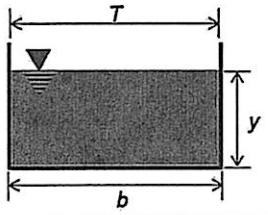
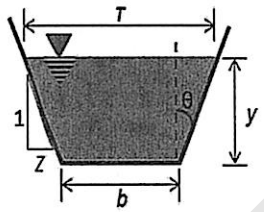
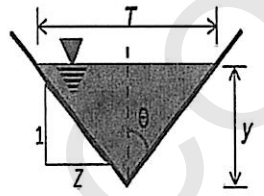
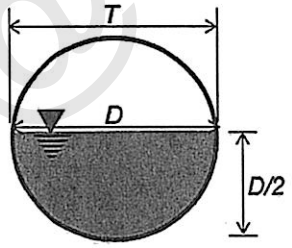
	Square	Rectangle	Triangle	Circle	Semi-circle
Shape					
Area	$A = B^2$	$A = BD$	$A = \frac{1}{2} BH$	$A = \frac{\pi d^2}{4}$	$A = \frac{\pi r^2}{2}$
I_c	$I_c = \frac{B^4}{12}$	$I_c = \frac{BD^3}{12}$	$I_c = \frac{BH^3}{36}$	$I_c = \frac{\pi d^4}{64}$	$I_c = 0.1102r^4$

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 	$A = \frac{\pi r^2}{2}$ @ $A = \frac{\pi D^2}{8}$	$P = \pi r$ @ $P = \frac{\pi D}{2}$	$T = D$