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 : 2025/2026

DCC50222 : HYDRAULICS

TARIKH : 06 MEI 2026
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas soalan ini mengandungi **SEPULUH (10)** 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** the questions.

ARAHAN:

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

QUESTION 1

SOALAN 1

CLO1 (a) When an object surface is submerged in a fluid, forces develop on the surface due to the fluid. Ilustrate the position of resultant force (F_R), centroid of object (C_g) and centre of pressure (C_p) acting on a plane surface submerged in a fluid.

Apabila permukaan objek terendam dalam bendalir, daya muncul pada permukaan disebabkan oleh bendalir tersebut. Gambar kedudukan daya paduan (F_R), titik tengah objek (C_g) dan pusat tekanan (C_p) yang bertindak pada permukaan satah yang tenggelam di dalam bendalir tersebut.

[4 marks]

[*4 markah*]

CLO1 (b) Explain the center of pressure of a triangular plate immersed vertically in water is located below the object's center of gravity.

Terangkan mengenai pusat tekanan bagi plat segitiga yang direndam secara menegak dalam air terletak di bawah pusat graviti objek.

[6 marks]

[*6 markah*]

CLO1

(c) A curved water gate with a radius of 1.8 m is shown in Figure A1(c). The length of the gate is 2 m, and the density of sea water is ρ = 1025 kg/m³. Determine the resultant hydrostatic force acting on the gate and the location of the centre of pressure due to the action of sea water.

Satu pintu air melengkung dengan jejari 1.8 m ditunjukkan dalam Rajah A1(c). Panjang pintu air tersebut ialah 2 m dan ketumpatan air laut ialah ρ = 1025 kg/m³. Tentukan daya hidrostatik paduan yang bertindak ke atas pintu air tersebut serta kedudukan pusat tekanan akibat tindakan air laut.

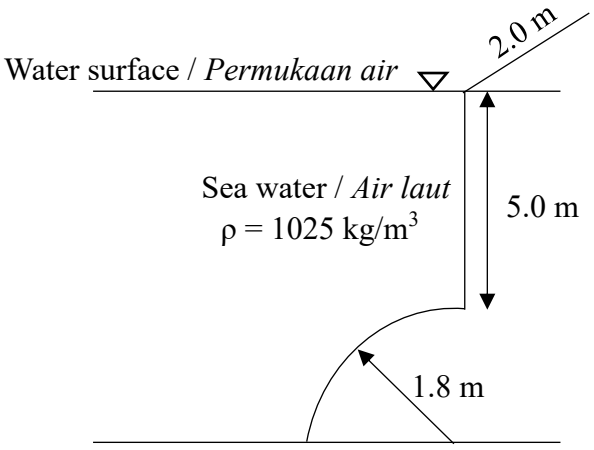


Figure A1(c) / *Rajah A1(c)*

[15 marks]

[*15 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) Explain buoyancy principle by illustrating diagram for floating and immersed object.

Terangkan prinsip keapungan beserta lakaran gambarajah bagi objek yang terapung dan tenggelam.

[4 marks]

[*4 markah*]

CLO1 (b) The lower density of the wood block than the water will float when released into the tank. Explain the principle of buoyancy that applies.

Ketumpatan bongkah kayu yang lebih rendah daripada air akan terapung apabila dilepaskan ke dalam tangki. Terangkan prinsip keapungan yang berlaku.

[6 marks]

[*6 markah*]

CLO1 (c) A floating cylindrical buoy with a diameter of 4.5 m and a length of 5 m has a weight of 165 kN. Determine that the cylinder can float vertically or otherwise in the water.

Sebuah silinder yang terapung dengan diameter 4.5 m dan panjang 5 m mempunyai berat 165 kN. Tentukan bahawa silinder tersebut dapat terapung secara menegak atau sebaliknya di dalam air.

[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) Open-channel flow can be classified as uniform and non-uniform flow according to its flow characteristics. Explain the uniform flow along with **TWO (2)** examples of the uses of uniform flow.
*Aliran saluran terbuka boleh dikelaskan sebagai aliran seragam dan tidak seragam mengikut ciri alirannya. Terangkan aliran seragam beserta **DUA (2)** contoh kegunaan aliran seragam.*

[4 marks]
[*4 markah*]

CLO2 (b) A trapezoidal channel has a 4.5 m wide base and side slopes of 3H:1V. It carries water with a depth of 4 m. Determine the value of Manning's constant if the discharge through the channel is 52 m^3/s. Assume the bed slope is 1:600.
Saluran berbentuk trapezoid mempunyai 4.5 m lebar tapak dan cerun sisi 3H:1V. Saluran ini membawa air pada kedalaman 4 m. Tentukan nilai pekali kekasaran Manning jika kadar alir melalui saluran ialah 52 m^3/s. Anggap cerun dasar saluran ialah 1:600.

[9 marks]
[*9 markah*]

CLO2 (c) Determine the most economical section of a rectangular channel carrying water at the rate of 0.5 m^3/s. The bed slope of the channels being 1 in 2000 and value of n, is 0.0158.

Tentukan keratan yang paling ekonomi bagi saluran segi empat tepat yang mengalirkan air pada kadar 0.5 m^3/s. Kecerunan dasar bagi saluran ialah 1 nisbah 2000 dan nilai n, ialah 0.0158.

[12 marks]

[*12 markah*]

QUESTION 2

SOALAN 2

CLO2 (a) Manning's coefficient of roughness, n is a coefficient that represents the roughness or friction of a channel to obtain a uniform or non-uniform flow value. Explain the use of the Manning formula, along with the meaning of each term in the formula.

Pekali kekasaran Manning's, n adalah pekali yang mewakili kekasaran atau geseran pada sesuatu saluran bagi mendapatkan nilai aliran seragam atau tidak seragam. Terangkan penggunaan formula Manning, berserta maksud setiap istilah dalam formula tersebut.

[4 marks]

[*4 markah*]

CLO2 (b) A triangular open channel with an apex angle of 65° has a Manning's roughness coefficient, n = 0.012 as shown in Figure B2(b). The channel carries water to a depth of 3.0 m and has a bed slope of S_o = 0.005. Using the Manning formula, calculate the discharge rate in the channel.

Saluran terbuka berbentuk segitiga mempunyai sudut 65° mempunyai pekali kekasaran Manning,n = 0.012 seperti ditunjukkan dalam Rajah B2(b). Saluran ini membawa air pada kedalaman 3.0 m dan mempunyai cerun dasar S_o = 0.005. Dengan menggunakan formula Manning, kirakan kadar alir dalam saluran tersebut.

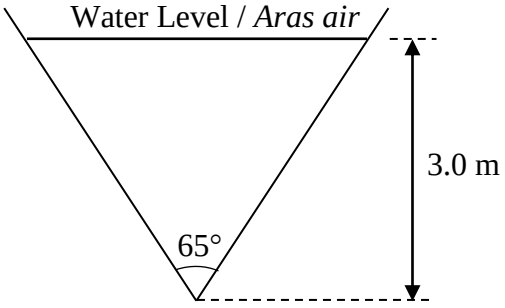


Figure B2(b) / *Rajah B2(b)*

[9 marks]

[*9 markah*]

CLO2

(c) A trapezoidal channel has a side 1 vertical and 2 horizontal and bed slopes 1 in 1800. The area of the section 28 m^2. Calculate the dimension and discharge rate of the channel if a section is an most economic section. Given the value of Manning's roughness coefficient, *n* is 0.017.

Satu saluran trapezoid mempunyai sisi 1 menegak dan 2 mendatar dan kecerunan dasar 1 nisbah 1800. Keluasan seksyen adalah 28 m^2. Kirakan dimensi dan kadar alir bagi saliran jika keratan paling ekonomi. Diberi nilai pekali kekasaran Manning,n ialah 0.017.

[12 marks]

[*12 markah*]

QUESTION 3

SOALAN 3

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

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

[4 marks]

[*4 markah*]

CLO2 (b) Froude number of flows in a rectangular channel is 0.9, with a channel width of 1.0 m and a flow depth of 1.8 m. Determine the critical depth and critical velocity.

Nombor Froude bagi aliran dalam saluran segi empat tepat ialah 0.9, dengan lebar saluran 1.0 m dan kedalaman aliran 1.8 m. Tentukan kedalaman kritikal dan halaju kritikal aliran tersebut.

[9 marks]

[*9 markah*]

CLO2 (c) For a hydraulic jump in a wide rectangular channel, the velocity and depth of flow before the jump are 6.2 m/s and 1.4 m, respectively. Determine the depth of flow after the jump, height of hydraulic jump, energy loss and type of jump.

Bagi lompatan hidraulik dalam satu saluran lebar segi empat tepat, halaju dan kedalaman aliran sebelum lompatan ialah 6.2 m/s dan 1.4 m. Tentukan kedalaman aliran selepas lompatan, ketinggian lompat hidraulik, kehilangan tenaga dan jenis lompatan.

[12 marks]

[*12 markah*]

QUESTION 4

SOALAN 4

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

Kedalaman kritikal dan kelajuan kritikal adalah parameter untuk aliran tidak sekata. Terangkan istilah bagi kedua-dua parameter tersebut.

[4 marks]

[*4 markah*]

CLO2 (b) Water is flowing through a rectangular channel of 5 m in width at a rate of 15 m^3/s. The depth of water in channel is 1.6 m. Calculate the specific energy for this flow and the minimum specific energy.

Air mengalir melalui saluran segi empat tepat selebar 5 m pada kadar 15 m^3/s. Kedalaman air dalam saluran tersebut adalah 1.6 m. Kirakan tenaga tentu aliran dan tenaga tentu minimum bagi aliran tersebut.

[9 marks]

[*9 markah*]

CLO2 (c) Water is flowing non-uniformly through a rectangular channel of 3 m width at a rate of 9.72 m^3/s. At a particular section of the channel, the depth of flow is 0.8 m. Determine the depth of flow after the jump, the loss of energy and power in the hydraulic jump.

Air mengalir tidak seragam melalui saluran segi empat tepat selebar 3 m pada kadar 9.72 m^3/s. Pada bahagian tertentu saluran, kedalaman aliran ialah 0.8 m. Tentukan kedalaman aliran selepas lompatan hidraulik, kehilangan tenaga, dan kuasa dalam lompat hidraulik.

[12 marks]

[*12 markah*]

SOALAN TAMAT

FORMULA DCC50222: HYDRAULICS

HYDROSTATIC FORCE

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

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

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

$$F_V = \rho \times g \times V$$

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

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

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

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

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

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

$$F_R = F_1 + F_2 + F_3$$

$$F_R = F_1 - F_2$$

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

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

BUOYANCY AND FLOATATION

$$W = \rho_b \times g \times V_b$$

$$F_B = \rho_f \times g \times V_d$$

$$BG = OG - OB$$

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

$$GM = BM - BG$$

UNIFORM OPEN CHANNEL

$$Q = A \times v$$

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

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

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

<u>Best hydraulics cross section</u>

Rectangular

$$b = 2y$$

Trapezoidal

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

Circular

$$r = y$$

NON-UNIFORM OPEN CHANNEL

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

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

$$F_r = \frac{v}{\sqrt{g \times y}}$$

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

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

$$\Delta y = y_2 - y_1$$

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

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

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

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

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

$$P = \rho \times Q \times g \times E_L$$

Table A1: *Geometric Properties of Plane Surface*

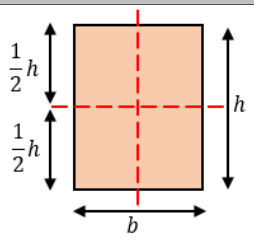
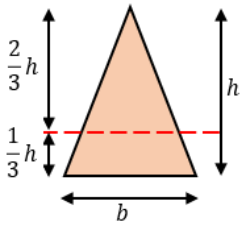
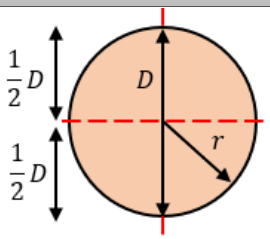
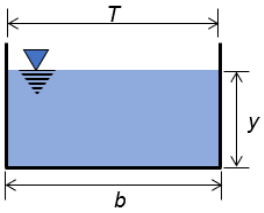
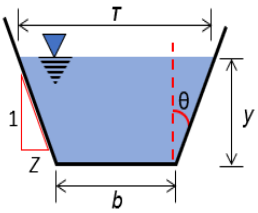
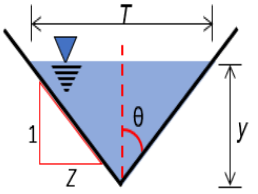
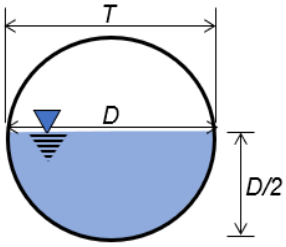
Shape	Rectangle	Triangle	Circle
			
Area, *A* (m^2)	$A = bh$	$A = \frac{1}{2}\, bh$	$A = \frac{\pi D^2}{4} = \pi r^2$
Moment of Inertia, I_c (m^4)	$I_c = \frac{bh^3}{12}$	$I_c = \frac{bh^3}{36}$	$I_c = \frac{\pi D^4}{64} = \frac{\pi r^4}{4}$

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 	$A = by + zy^2$	$P = b + 2y\sqrt{1+z^2}$	$T = b + 2zy$
	$A = by + y^2(\tan\theta)$	$P = b + 2y\sqrt{1+(\tan\theta)^2}$	$T = b + 2y(\tan\theta)$
Triangular 	$A = zy^2$	$P = 2y\sqrt{1+z^2}$	$T = 2zy$
	$A = y^2(\tan\theta)$	$P = 2y\sqrt{1+(\tan\theta)^2}$	$T = 2y(\tan\theta)$
Semi-circular 	$A = \frac{\pi r^2}{2}$	$P = \pi r$	$T = 2r$
	$A = \frac{\pi D^2}{8}$	$P = \frac{\pi D}{2}$	$T = D$