

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 ELEKTRIK

PEPERIKSAAN AKHIR

SESI II : 2024/2025

DEE40113: SIGNAL AND SYSTEM

TARIKH : 23 MEI 2025

MASA : 3.00 PTG – 5.00 PTG (2 JAM)

Kertas soalan ini mengandungi **LAPAN (8)** halaman bercetak.

Bahagian A: Subjektif (3 soalan)

Bahagian B: Esei (2 soalan)

Dokumen sokongan yang disertakan : Appendix

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

SECTION A : 60 MARKS**BAHAGIAN A : 60 MARKAH****INSTRUCTION:**

This section consists of **THREE (3)** structured questions. Answer **ALL** questions.

ARAHAN :

Bahagian ini mengandungi **TIGA (3)** soalan berstruktur. Jawab **SEMUA** soalan.

QUESTION 1**SOALAN 1**

- CLO1 (a) Visualize the graph using the given equation

$$f(t) = u(t + 1) - u(t)$$

Lakarkan graf melalui persamaan yang diberi

$$f(t) = u(t + 1) - u(t)$$

[4 marks]

[4 markah]

- CLO1 (b) Sketch the even and odd signal for the continuous time-domain signal shown in Figure A1(b)(i) and the discrete-time signal shown in Figure A1(b)(ii).

Lakarkan isyarat genap dan ganjil bagi isyarat masa berterusan yang ditunjukkan dalam Rajah A1(b)(i) dan isyarat masa diskrit Rajah A1(b)(ii).

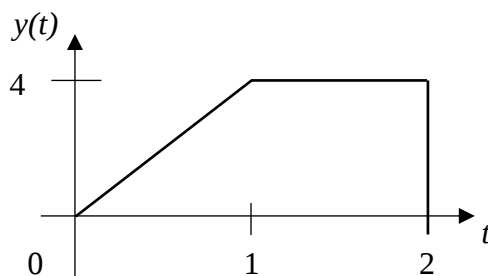


Figure A1(b)(i) / Rajah A1(b)(i)

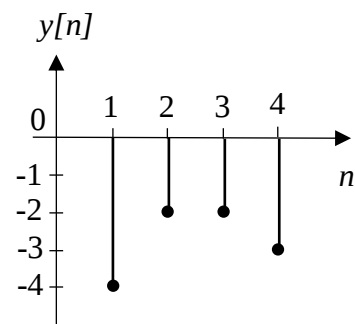


Figure A1(b)(ii) / Rajah A1(b)(ii)

[8 marks]

[8 markah]

CLO1 (c) A discrete-time signal is as shown in the Figure A1(c) below. Sketch the following signals:

- i. $x[n - 3]$
- ii. $x[2n]$
- iii. $x[n + 2]$
- iv. $x[-n]$

Isyarat masa diskret adalah seperti yang ditunjukkan dalam Rajah A1(c) di bawah. Lakarkan isyarat berikut:

- i. $x[n - 3]$
- ii. $x[2n]$
- iii. $x[n + 2]$
- iv. $x[-n]$

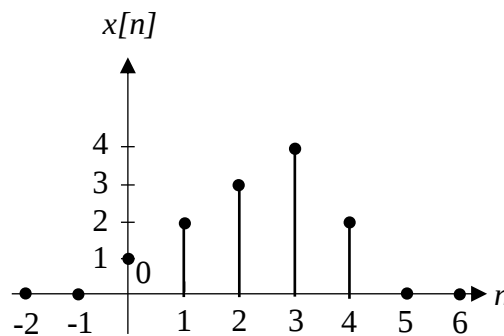


Figure A1(c) / Rajah A1(c)

[8 marks]

[8 markah]

QUESTION 2**SOALAN 2**

- CLO1 (a) Explain convolution of continuous-Time Linear Time-Invariant (LTI) system.
Terangkan konvolusi sistem Masa-Berterusan Linear Varian-Bukan Pemasa.
 [4 marks]
 [4 markah]
- CLO1 (b) Consider LTI system with the impulse signal $x[n] = \{2 \ 5 \ 0 \ 4\}$ and input $h[n] = \{4 \ 1 \ 3\}$
 $\uparrow \qquad \qquad \qquad \uparrow$
 If an output $y[n]$ is the response of the discrete convolution sum LTI system derive its expression using discrete convolution sum.

Pertimbangkan LTI sistem dengan isyarat $x[n] = \{2 \ 5 \ 0 \ 4\}$ dan $h[n] = \{4 \ 1 \ 3\}$.
 $\uparrow \qquad \qquad \qquad \uparrow$
Jika keluaran $y[n]$ adalah tindak balas sistem LTI isyarat masa berjujukan, dapatkan ungkapan dengan menggunakan isyarat masa berjujukan konvolusi jumlah.
 [8 marks]
 [8 markah]

- CLO1 (c) Consider the signal $x(t)$ and $h(t)$ shown in Diagram A2(c)(i) and Diagram A2(c)(ii). If an output $y(t)$ is the response of the continuous time LTI system determine its expression using convolution integral.

Pertimbangkan isyarat $x(t)$ dan $h(t)$ ditunjukkan dalam Rajah A2(c)(i) dan Rajah A2(c)(ii). Jika keluaran $y(t)$ adalah tindak balas sistem LTI masa yang berterusan, tentukan ungkapan dengan menggunakan konvolusi kamiran.

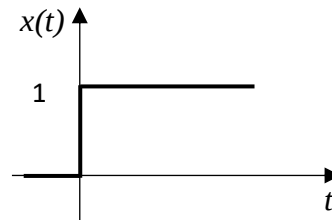


Figure A2(c)(i) / Rajah A2(c)(i)

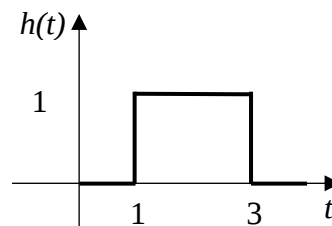


Figure A2(c)(ii) / Rajah A2(c)(ii)

[8 marks]

[8 markah]

QUESTION 3**SOALAN 3**

CLO1

- (a) Convert the Laplace transform of the following signal:

Tukarkan penjelmaan Laplace bagi isyarat berikut:

i) $g(t) = 3e^{-2t}u(t)$

ii) $h(t) = 5\cos 2tu(t)$

[4 marks]

[4 markah]

CLO1

- (b) Show the following Inverse Laplace Transform by using partial fraction expansion method.

Tunjukkan Jelmaan Laplace Songsang berikut dengan menggunakan kaedah pengembangan pecahan separa :

$$G(s) = \frac{s^2 + 4s + 5}{(s + 3)(s^2 + 2s + 2)}$$

[8 marks]

[8 markah]

CLO1

- (c) Compute
- $y[n] = x[n] * h[n]$
- of a discrete-time LTI systems given by using analytical A.

*Kirakan $y[n] = x[n] * h[n]$ bagi system LTI masa diskrit yang diberi dengan menggunakan kaedah analytical A.*

$$x[n] = 2\delta[n - 2] + 3\delta[n + 1]$$

$$h[n] = \delta[n]n + \delta[n - 1] + \delta[n - 2]$$

[8 marks]

[8 markah]

SECTION B : 40 MARKS**BAHAGIAN B :40 MARKAH****INSTRUCTION:**

This section consists of **TWO (2)** essay questions. Answer the question.

ARAHAN:

*Bahagian ini mengandungi **DUA (2)** soalan esei. Jawab soalan tersebut.*

QUESTION 1**SOALAN 1**

- CLO1 Given a continuous-time Linear Time-Invariant (LTI) system, determine the Laplace Transform to derive the second-order differential equation in the time domain.

$$\frac{d^2v(t)}{dt^2} + 5\frac{dv(t)}{dt} + 6v(t) = 10e^{-2t}$$

Diberikan satu sistem LTI (Linear Time-Invariant) dalam bentuk masa berterusan.

Tentukan Transformasi Laplace untuk mendapatkan persamaan pembezaan bagi

sistem ini yang melibatkan terbitan kedua :

$$\frac{d^2v(t)}{dt^2} + 5\frac{dv(t)}{dt} + 6v(t) = 10e^{-2t}$$

[20 marks]

[20 markah]

QUESTION 2**SOALAN 2**

- CLO1 A periodic rectangular signal $f(t)$ is shown in Figure B2, with a fundamental period of $T=2$. Evaluate its representation using the Trigonometric Fourier Series with expansion up to the 8th harmonic.

Diberikan satu isyarat segi empat berkala $f(t)$ seperti dalam Rajah B2, dengan tempoh asas $T=2$. Nilaiakan perwakilan isyarat ini menggunakan Siri Fourier Trigonometri dan nyatakan pengembangannya secara jelas sehingga ke harmonik ke-8.

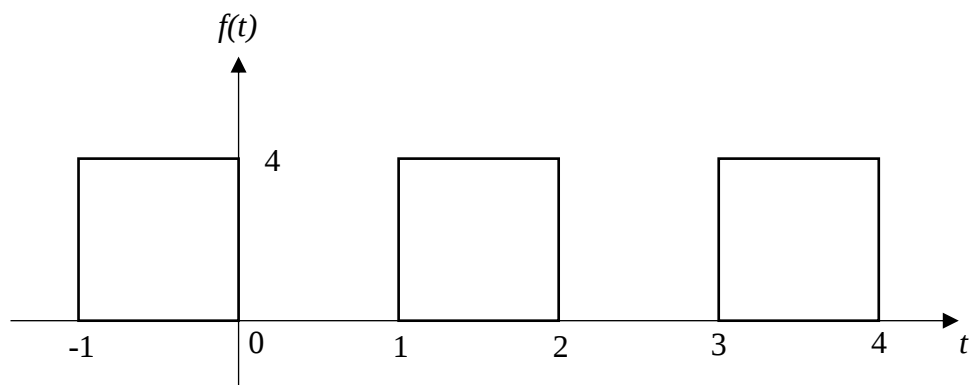


Figure B2 / Rajah B2

[20 marks]

[20 markah]

SOALAN TAMAT

Laplace Transform Pairs

$x(t)$	$X(s)$	ROC
$\delta(t)$	1	All s
$u(t)$	$\frac{1}{s}$	$\text{Re}(s) > 0$
$-u(-t)$	$\frac{1}{s}$	$\text{Re}(s) < 0$
$tu(t)$	$\frac{1}{s^2}$	$\text{Re}(s) > 0$
$t^k u(t)$	$\frac{k!}{s^{k+1}}$	$\text{Re}(s) > 0$
$e^{-at} u(t)$	$\frac{1}{s + a}$	$\text{Re}(s) > -\text{Re}(a)$
$-e^{-at} u(-t)$	$\frac{1}{s + a}$	$\text{Re}(s) < -\text{Re}(a)$
$te^{-at} u(t)$	$\frac{1}{(s + a)^2}$	$\text{Re}(s) > -\text{Re}(a)$
$-te^{-at} u(-t)$	$\frac{1}{(s + a)^2}$	$\text{Re}(s) < -\text{Re}(a)$
$\cos \omega_0 tu(t)$	$\frac{s}{s^2 + \omega_0^2}$	$\text{Re}(s) > 0$
$\sin \omega_0 tu(t)$	$\frac{\omega_0}{s^2 + \omega_0^2}$	$\text{Re}(s) > 0$
$e^{-at} \cos \omega_0 tu(t)$	$\frac{s + a}{(s + a)^2 + \omega_0^2}$	$\text{Re}(s) > -\text{Re}(a)$
$e^{-at} \sin \omega_0 tu(t)$	$\frac{\omega_0}{(s + a)^2 + \omega_0^2}$	$\text{Re}(s) > -\text{Re}(a)$

Appendix 2

Z-Transform Pairs

$x[n]$	$X(z)$	ROC
$\delta[n]$	1	All z
$u[n]$	$\frac{1}{1-z^{-1}}, \frac{z}{z-1}$	$ z > 1$
$-u[-n-1]$	$\frac{1}{1-z^{-1}}, \frac{z}{z-1}$	$ z < 1$
$\delta[n-m]$	z^{-m}	All z except 0 if $(m > 0)$ or ∞ if $(m < 0)$
$a^n u[n]$	$\frac{1}{1-az^{-1}}, \frac{z}{z-a}$	$ z > a $
$-a^n u[-n-1]$	$\frac{1}{1-az^{-1}}, \frac{z}{z-a}$	$ z < a $
$na^n u[n]$	$\frac{az^{-1}}{(1-az^{-1})^2}, \frac{az}{(z-a)^2}$	$ z > a $
$-na^n u[-n-1]$	$\frac{az^{-1}}{(1-az^{-1})^2}, \frac{az}{(z-a)^2}$	$ z < a $
$(n+1)a^n u[n]$	$\frac{1}{(1-az^{-1})^2}, \left[\frac{z}{z-a} \right]^2$	$ z > a $
$(\cos \Omega_0 n)u[n]$	$\frac{z^2 - (\cos \Omega_0)z}{z^2 - (2 \cos \Omega_0)z + 1}$	$ z > 1$
$(\sin \Omega_0 n)u[n]$	$\frac{(\sin \Omega_0)z}{z^2 - (2 \cos \Omega_0)z + 1}$	$ z > 1$
$(r^n \cos \Omega_0 n)u[n]$	$\frac{z^2 - (r \cos \Omega_0)z}{z^2 - (2r \cos \Omega_0)z + r^2}$	$ z > r$
$(r^n \sin \Omega_0 n)u[n]$	$\frac{(r \sin \Omega_0)z}{z^2 - (2r \cos \Omega_0)z + r^2}$	$ z > r$
$\begin{cases} a^n & 0 \leq n \leq N-1 \\ 0 & \text{otherwise} \end{cases}$	$\frac{1-a^N z^{-N}}{1-az^{-1}}$	$ z > 0$

Fourier Transform Pair

$x(t)$	$X(\omega)$
$\delta(t)$	1
$\delta(t - t_0)$	$e^{-j\omega t_0}$
1	$2\pi\delta(\omega)$
$e^{j\omega_0 t}$	$2\pi\delta(\omega - \omega_0)$
$\cos \omega_0 t$	$\pi[\delta(\omega - \omega_0) + \delta(\omega + \omega_0)]$
$\sin \omega_0 t$	$-j\pi[\delta(\omega - \omega_0) - \delta(\omega + \omega_0)]$
$u(t)$	$\pi\delta(\omega) + \frac{1}{j\omega}$
$u(-t)$	$\pi\delta(\omega) - \frac{1}{j\omega}$
$e^{-at}u(t), a > 0$	$\frac{1}{j\omega + a}$
$te^{-at}u(t), a > 0$	$\frac{1}{(j\omega + a)^2}$
$e^{-a t }, a > 0$	$\frac{2a}{a^2 + \omega^2}$
$\frac{1}{a^2 + t^2}$	$e^{-a \omega }$
$e^{-at^2}, a > 0$	$\sqrt{\frac{\pi}{a}} e^{-\omega^2/4a}$
$p_a(t) = \begin{cases} 1 & t < a \\ 0 & t > a \end{cases}$	$2a \frac{\sin \omega a}{\omega a}$
$\frac{\sin at}{\pi t}$	$p_a(\omega) = \begin{cases} 1 & \omega < a \\ 0 & \omega > a \end{cases}$
$\text{sgn } t$	$\frac{2}{j\omega}$
$\sum_{k=-\infty}^{\infty} \delta(t - kT)$	$\omega_0 \sum_{k=-\infty}^{\infty} \delta(\omega - k\omega_0), \omega_0 = \frac{2\pi}{T}$

Properties of the Fourier Transform

PROPERTY	SIGNAL	FOURIER TRANSFORM
	$x(t)$	$X(\omega)$
	$x_1(t)$	$X_1(\omega)$
	$x_2(t)$	$X_2(\omega)$
Linearity	$a_1x_1(t) + a_2x_2(t)$	$a_1X_1(\omega) + a_2X_2(\omega)$
Time shifting	$x(t - t_0)$	$e^{-j\omega t_0} X(\omega)$
Frequency shifting	$e^{j\omega_0 t} x(t)$	$X(\omega - \omega_0)$
Time scaling	$x(at)$	$\frac{1}{ a } X\left(\frac{\omega}{a}\right)$
Time reversal	$x(-t)$	$X(-\omega)$
Duality	$X(t)$	$2\pi x(-\omega)$
Time differentiation	$\frac{dx(t)}{dt}$	$j\omega X(\omega)$
Frequency differentiation	$(-jt)x(t)$	$\frac{dX(\omega)}{d\omega}$
Integration	$\int_{-\infty}^t x(\tau) d\tau$	$\pi X(0) \delta(\omega) + \frac{1}{j\omega} X(\omega)$
Convolution	$x_1(t) * x_2(t)$	$X_1(\omega)X_2(\omega)$
Multiplication	$x_1(t)x_2(t)$	$\frac{1}{2\pi} X_1(\omega) * X_2(\omega)$
Real signal	$x(t) = x_e(t) + x_o(t)$	$X(\omega) = A(\omega) + jB(\omega)$ $X(-\omega) = X^*(\omega)$
Even component	$x_e(t)$	$\text{Re}\{X(\omega)\} = A(\omega)$
Odd component	$x_o(t)$	$j \text{Im}\{X(\omega)\} = jB(\omega)$
Parseval's relations	$\int_{-\infty}^{\infty} x_1(\lambda)X_2(\lambda) d\lambda = \int_{-\infty}^{\infty} X_1(\lambda)x_2(\lambda) d\lambda$ $\int_{-\infty}^{\infty} x_1(t)x_2(t) dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} X_1(\omega)X_2(-\omega) d\omega$ $\int_{-\infty}^{\infty} x(t) ^2 dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} X(\omega) ^2 d\omega$	

TABLE 3.1(a): COMMON LAPLACE TRANSFORM PAIRS

	$f(t) = L^{-1}\{F(s)\}$	$F(s) = L\{f(t)\}$		$f(t) = L^{-1}\{F(s)\}$	$F(s) = L\{f(t)\}$
1	$\delta(t)$	1	2	$-u(-t)$	$\frac{1}{s}$
			4	$u(t)$	$\frac{1}{s}$
3	$t^k u(t)$	$\frac{k!}{s^{k+1}}$	6	$tu(t)$	$\frac{1}{s^2}$
5	$-e^{-at}u(-t)$	$\frac{1}{s+a}$	8	$e^{at}u(t)$	$\frac{1}{s-a}$
7	$-te^{-at}u(-t)$	$\frac{1}{(s+a)^2}$	10	$te^{-at}u(t)$	$\frac{1}{(s+a)^2}$
9	$u(t)\sin(at)$	$\frac{a}{s^2+a^2}$	12	$u(t)\cos(at)$	$\frac{s}{s^2+a^2}$
11	$e^{at}u(t)\sin(bt)$	$\frac{b}{(s-a)^2+b^2}$	14	$e^{at}u(t)\cos(bt)$	$\frac{s-a}{(s-a)^2+b^2}$
13	$f'(t)$	$sF(s)-f(0)$		$f''(t)$	$s^2F(s)-sf(0)-f'(0)$
15	$\int_0^t f(v)dv$	$\frac{F(s)}{s}$	16	$\int_{-\infty}^t f(v)dv$	$\frac{F(s)}{s} + \frac{1}{s} \int_{-\infty}^{0-} f(v)dv$

TABLE 3.1(b): LAPLACE TRANSFORM PROPERTIES

		Laplace Transform $X(s)=\{f(t)\}$	
1	Linearity	$ax_1(t) + bx_2(t)$	$aX_1(s) + bX_2(s)$
2	Time shifting	$x(t-t_0)$	$e^{-st_0}X(s)$
3	Shifting in s	$e^{-st_0}x(t)$	$X(s-s_0)$
4	Time scaling	$x(at)$	$\frac{1}{ a }X\left(\frac{s}{a}\right)$
5	Time reversal	$x(-t)$	$X(-s)$
6	Differentiation in t	$\frac{dx(t)}{dt}$	$sX(s)$
8	Convolution	$x_1(t) * x_2(t)$	$X_1(s)X_2(s)$
9	Integration	$\int_{-\infty}^t x(\tau)d\tau$	$\frac{1}{s}X(s) + \frac{1}{s} \int_{-\infty}^{0-} x(\tau)d\tau$