KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

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

JABATAN KEJURUTERAAN ELEKTRIKAL

PEPERIKSAAN AKHIR

SESI II : 2022/2023

DEE40113: SIGNAL AND SYSTEM

TARIKH : 06 JUN 2023
MASA : 11.15 PG - 1.15 PTG (2 JAM)

Kertas ini mengandungi **LAPAN (8)** halaman bercetak.
Bahagian A: Subjektif (3 soalan)
Bahagian B: Esei (2 soalan)
Dokumen sokongan yang disertakan : Formula Laplace Transform, Z Transform, Fourier Transform

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JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SECTION A : 60 MARKS

BAHAGIAN A : 60 MARKAH

INSTRUCTION:

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

ARAHAN :

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

QUESTION 1

SOALAN 1

CLO1 (a) Signal and system are an introduction to analog and digital signal processing. Explain with **ONE (1)** example of signal and system.

*Isyarat dan sistem adalah pengenalan kepada pemprosesan isyarat analog dan digital. Terangkan beserta **SATU (1)** contoh bagi isyarat dan sistem.*

[4 marks]

[*4 markah*]

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

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

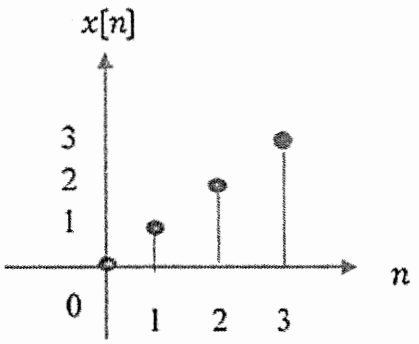

Figure A1(b) / *Rajah A1(b)*

[8 marks]

[*8 markah*]

CLO1 (c) A discrete-time signals $x_a[n]$ and $x_b[n]$ shown in Figure A1(c-i) and Figure A1(c-ii). Draw the following signal:

Isyarat masa diskrit $x_a[n]$ dan $x_b[n]$ ditunjukkan dalam Rajah A1(c-i) dan Rajah A1(c-ii). Lukiskan isyarat berikut:

$$y_1[n] = x_a[n] + x_b[n]$$

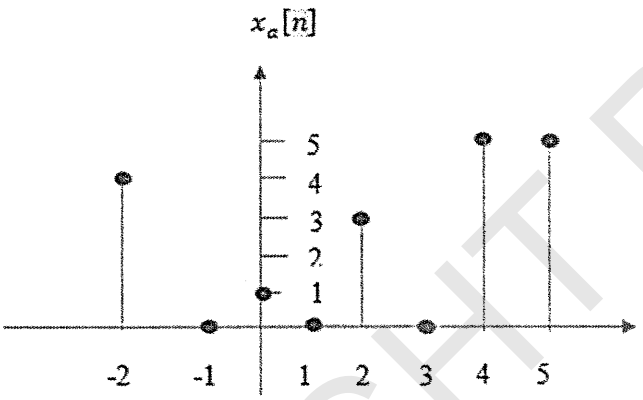

Figure A1(c-i) / *Rajah A1(c-i)*

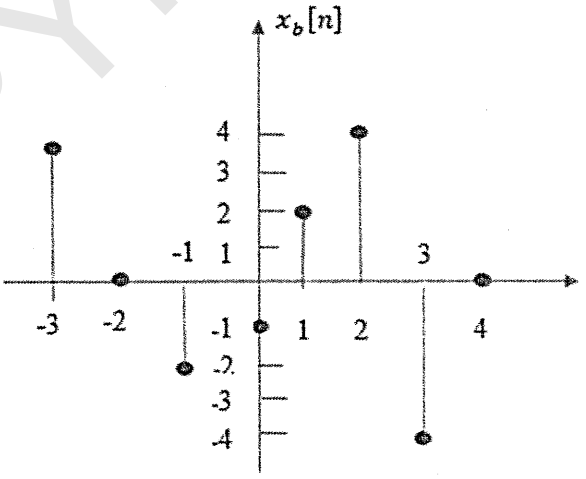

Figure A1(c-ii) / *Rajah A1(c-ii)*

[8 marks]

[*8 markah*]

QUESTION 2

SOALAN 2

CLO1

(a) LTI systems are a class of systems used in signals and systems that are both linear and time-invariant. Elaborate **TWO (2)** properties and equation of convolution integral in LTI systems.

*Sistem LTI ialah kelas sistem yang digunakan dalam isyarat dan sistem yang linear dan invarian masa. Huraikan secara terperinci **DUA (2)** ciri dan persamaan bagi konvolusi kamiran dalam sistem LTI.*

[4 marks]

[*4 markah*]

(b) Sketch the output of $y(t) = x(t) * h(t)$ by using analytical technique, where $x(t)$ and $h(t)$ are shown in Figure A2(b-i) and Figure A2(b-ii).

Lakarkan keluaran bagi $y(t) = x(t) * h(t)$ menggunakan kaedah analisis, dimana $x(t)$ dan $h(t)$ ditunjukkan dalam Rajah A2(b-i) dan Rajah A2(b-ii).

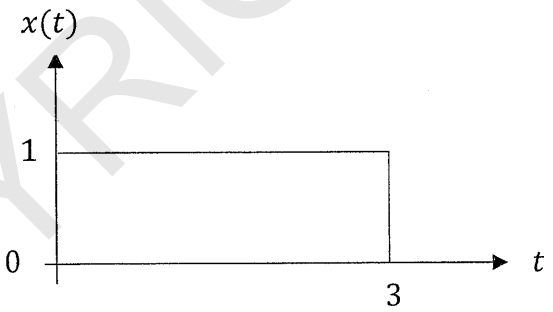

Figure A2(b-i) / *Rajah A2(b-i)*

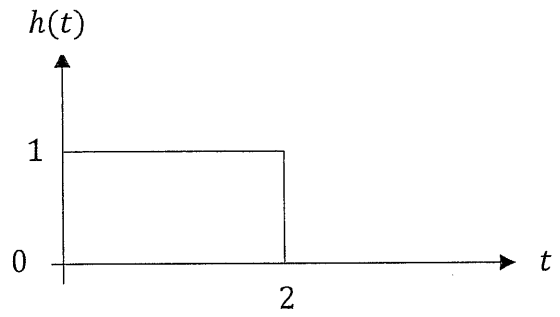

Figure A2(b-ii) / *Rajah A2(b-ii)*

[8 marks]

[*8 markah*]

CLO1 (c) Compute $y[n] = x[n] * h[n]$ of a discrete-time LTI systems given by using analytical technique.

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

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

[8 marks]

[*8 markah*]

QUESTION 3

SOALAN 3

CLO1 (a) Express the Laplace Transform with a ROC plot of the following real exponential signal:

Nyatakan Jelmaan Laplace beserta plot ROC bagi isyarat eksponen sebenar berikut:

$$x(t) = e^{-2t}\,u(t) + e^{-3t}\,u(t)$$

[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:

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

[8 marks]

[*8 markah*]

CLO1

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

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

$$x[n] = \delta[n-2] - \delta[n-4]$$

$$h[n] = \delta[n+1] + \delta[n] + \delta[n-1] + \delta[n-2] - \delta[n-3] - \delta[n-4]$$

[8 marks]

[*8 markah*]

SECTION B : 40 MARKS

BAHAGIAN B : 40 MARKAH

INSTRUCTION:

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

ARAHAN:

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

CLO1

QUESTION 1

SOALAN 1

The output y[n] of a discrete-time LTI system is found to be $2(\frac{1}{3})^n u[n]$ when the input x[n] is u[n]. Analyze the output y[n] using Z-Transform when the input of x[n] is $(\frac{1}{2})^n u[n]$.

Keluaran y[n] bagi sistem LTI masa diskrit adalah $2(\frac{1}{3})^n u[n]$ *apabila masukan x[n] ialah u[n]. Analisis keluaran y[n] menggunakan Jelmaan Z apabila masukan x[n] ialah* $(\frac{1}{2})^n u[n]$.

[20 marks]

[*20 markah*]

CLO1

QUESTION 2

SOALAN 2

Figure B2 is an example of a continuous rectangular signal. The function of the signal can be expressed in Trigonometric Fourier Series and Complex Exponential Fourier Series. Evaluate the signal f(t) in the Complex Exponential Fourier Series.

Rajah B2 merupakan contoh isyarat terus segiempat. Fungsi isyarat ini boleh dinyatakan dalam Siri Fourier Trigonometrik dan Siri Fourier Eksponen Kompleks. Nilaikan isyarat f(t) dalam Siri Fourier Eksponen Kompleks.

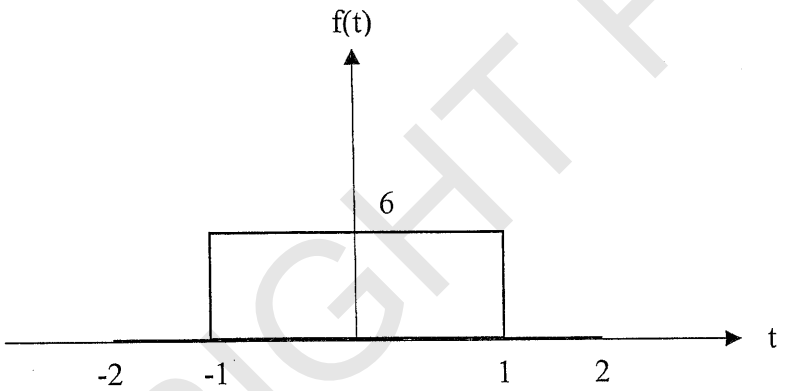

Figure B2 / *Rajah B2*

[20 marks]

[*20 markah*]

SOALAN TAMAT

FORMULA FOR DEE40113 SIGNAL AND SYSTEM

LAPLACE TRANSFORM PAIRS

$f(t)$	$F(s)$
$\partial(t)$	1
$u(t)$	$\frac{1}{s}$
a	$\frac{a}{s}$
$t^n, n=1,2,3,...$	$\frac{n!}{s^{n+1}}$
e^{at}	$\frac{1}{s-a}$
$\sin at$	$\frac{a}{s^2+a^2}$
$\cos at$	$\frac{s}{s^2+a^2}$
$\sin(at+\theta)$	$\frac{s\sin\theta+a\cos\theta}{s^2+a^2}$
$\cos(at+\theta)$	$\frac{s\cos\theta-a\sin\theta}{s^2+a^2}$
$e^{-at}\sin bt$	$\frac{b}{(s+a)^2+b^2}$
$e^{-at}\cos bt$	$\frac{s+a}{(s+a)^2+b^2}$
$t^n e^{-at}$	$\frac{n!}{(s+a)^{n+1}}$
$\sinh at$	$\frac{a}{s^2-a^2}$
$\cosh at$	$\frac{s}{s^2-a^2}$

FORMULA FOR DEE40113 SIGNAL AND SYSTEM

Z TRANSFORM PAIRS

$x(t)$	$X(s)$	$X(z)$
$\partial(t)=\begin{cases}1 & t=0\\ 0 & t=kT,\ k\neq 0\end{cases}$	1	1
$\partial(t-kT)=\begin{cases}1 & t=kT\\ 0 & t\neq kT\end{cases}$	e^{-kTs}	Z^{-k}
$u(t)$, *unit step*	$\frac{1}{s}$	$\frac{z}{z-1}$
t	$\frac{1}{s^2}$	$\frac{Tz}{(z-1)^2}$
t^2	$\frac{2}{s^3}$	$\frac{T^2z(z+1)}{(z-1)^3}$
e^{-at}	$\frac{1}{s+a}$	$\frac{z}{z-e^{-aT}}$
$1-e^{-at}$	$\frac{a}{s(s+a)}$	$\frac{(1-e^{-aT})z}{(z-1)(z-e^{-aT})}$
te^{-at}	$\frac{1}{(s+a)^2}$	$\frac{Tze^{-aT}}{(z-e^{-aT})^2}$
t^2e^{-at}	$\frac{2}{(s+a)^3}$	$\frac{T^2e^{-aT}z(z+e^{-aT})}{(z-e^{-aT})^3}$
$\sin\omega t$	$\frac{\omega}{s^2+\omega^2}$	$\frac{z\sin\omega T}{z^2-2z\cos\omega T+1}$
$\cos\omega t$	$\frac{s}{s^2+\omega^2}$	$\frac{z(z-\cos\omega T)}{z^2-2z\cos\omega T+1}$
$e^{-at}\sin\omega t$	$\frac{\omega}{(s+a)^2+\omega^2}$	$\frac{(ze^{-aT}\sin\omega T)}{z^2-2ze^{-aT}\cos\omega T+e^{-2aT}}$
$e^{-at}\cos\omega t$	$\frac{s+a}{(s+a)^2+\omega^2}$	$\frac{(z^2-ze^{-aT}\cos\omega T)}{z^2-2ze^{aT}\cos\omega T+e^{2aT}}$

FORMULA FOR DEE40113 SIGNAL AND SYSTEM

FOURIER TRANSFORM PAIRS

$f(t)$	$F(\omega)$
$\partial(t)$	1
1	$2\pi\partial(\omega)$
$u(t)$	$\pi\partial(\omega)+\frac{1}{j\omega}$
$u(t+\tau)-u(t-\tau)$	$2\frac{\sin\omega\tau}{\omega}$
$\lvert t\rvert$	$\frac{-2}{\omega^2}$
$\text{sgn}(t)$	$\frac{2}{j\omega}$
$e^{-at}u(t)$	$\frac{1}{a+j\omega}$
$e^{-at}u(-t)$	$\frac{1}{a-j\omega}$
$t^n e^{-at}u(t)$	$\frac{n!}{(a+j\omega)^{n+1}}$
$e^{-a\lvert t\rvert}$	$\frac{2a}{a^2+\omega^2}$
$e^{j\omega_o t}$	$2\pi\partial(\omega-\omega_o)$
$\sin\omega_o t$	$j\pi[\partial(\omega+\omega_o)-\partial(\omega-\omega_o)]$
$\cos\omega_o t$	$\pi[\partial(\omega+\omega_o)+\partial(\omega-\omega_o)]$
$\sin(\omega t+\theta)$	$\frac{s\sin\theta+\omega\cos\theta}{s^2+\omega^2}$
$\cos(\omega t+\theta)$	$\frac{s\cos\theta-\omega\sin\theta}{s^2+\omega^2}$
$e^{-at}\sin\omega_o t\,u(t)$	$\frac{\omega_o}{(a+j\omega)^2+\omega_o{}^2}$
$e^{-at}\cos\omega_o t\,u(t)$	$\frac{a+j\omega}{(a+j\omega)^2+\omega_o{}^2}$