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 : 2025/2026

DEE40113 : SIGNAL AND SYSTEM

TARIKH : 15 MEI 2026
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas soalan ini mengandungi **LAPAN (8)** halaman bercetak.
Bahagian A: Struktur (3 soalan)
Bahagian B: Esei (2 soalan)
Dokumen sokongan yang disertakan : APPENDIX 1 , APPENDIX C

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)** structured questions. Answer **ALL** questions.

ARAHAN :

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

QUESTION 1

SOALAN 1

CLO1 (a) Explain whether the following system is a memory or memoryless system. Assume t = 1 is present time.

$$y(t) = x(t-1) + 2x(t+2)$$

Terangkan sama ada sistem berikut mempunyai ingatan atau tidak mempunyai ingatan. Anggapkan t=1 adalah masa semasa.

$$y(t) = x(t-1) + 2x(t+2)$$

[4 marks]

[*4 markah*]

CLO1 (b) The discrete-time signal f(n) is defined as

$$\boldsymbol{f(n) = x(n)[u(n+2) - u(n-1)].}$$

Given the discrete-time signal x(n) as shown in Figure A1(b), sketch the output signal f(n).

Isyarat masa diskrit f(t) ditakrifkan sebagai

$$\boldsymbol{f(n) = x(n)[u(n+2) - u(n-1)].}$$

Diberikan isyarat masukan masa diskrit x(n) seperti yang ditunjukkan dalam Rajah A1(b), lakarkan isyarat keluaran f(n).

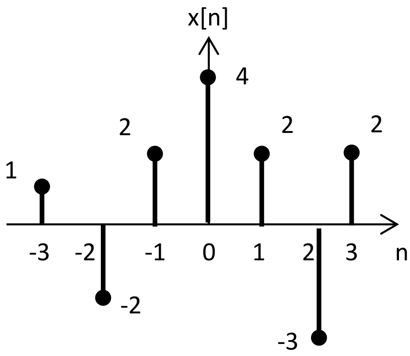

Figure A1(b) / *Rajah A1(b)*

[8 marks]
[*8 markah*]

CLO1 (c) Sketch the odd and even signals of Figure A1 (c).

Lakarkan isyarat ganjil dan genap bagi Rajah A1(c).

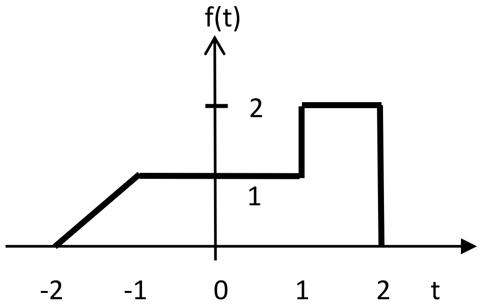

Figure A1(c) / *Rajah A1(c)*

[8 marks]
[*8 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) By referring to Figure A2(a), express the input-output relationship for the block diagram of continuous-time LTI system.

Dengan merujuk kepada Rajah A2(a), dapatkan hubungan masukan-keluaran bagi gambarajah blok sistem LTI masa selanjar.

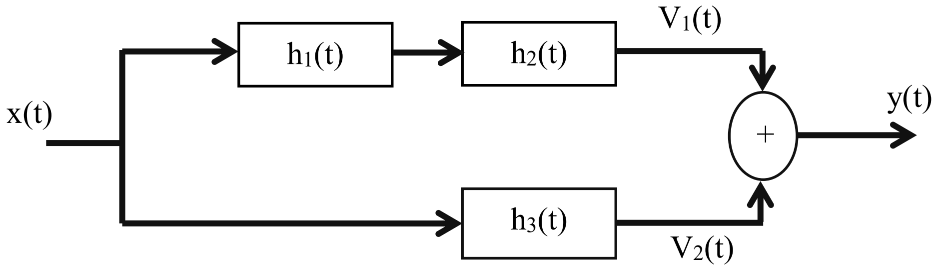

Figure A2(a) / *Rajah A2(a)*

[4 marks]

[*4 markah*]

CLO1 (b) For a discrete-time LTI system, the output of the system y(n) is produced by convolving the input signal x(n) with the system impulse response h(n). Sketch the output signal y[n] by using the graphical method where x(n) = [<u>2</u>, 0, -1] and h(n) = [<u>2</u>, 3, 1].

Untuk sebuah sistem LTI masa diskrit, keluaran sistem y(n) dihasilkan dengan membuat konvolusi antara isyarat masukan x(n) dengan sistem sambutan dedenyut h(n). Lakarkan keluaran y[n] dengan menggunakan kaedah grafik dimana x[n] = [2, 0, -1] dan h[n] = [<u>2</u>, 3, 1].

[8 marks]

[*8 markah*]

CLO1 (c) Use the convolution integral equation to obtain the output y(t) of the continuous-time LTI system, given the input signal x(t) and impulse response h(t) as shown in Figure A2(c).

Gunakan persamaan kamiran konvolusi untuk mendapatkan keluaran y(t) bagi sebuah sistem LTI masa selanjar, diberi isyarat masukan x(t) dan sambutan dedenyut h(t) adalah seperti yang ditunjukkan dalam Rajah A2(c).

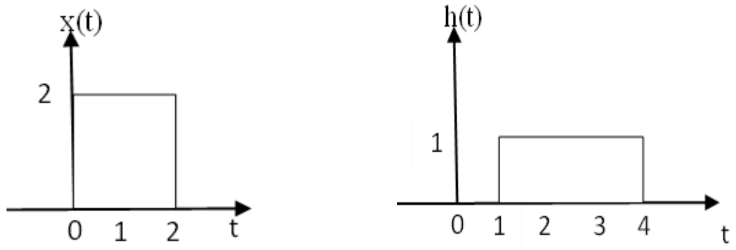

Figure A2(c) / *Rajah A2(c)*

[8 marks]

[*8 markah*]

QUESTION 3

SOALAN 3

CLO1 (a) Represent a stable and causal continuous-time LTI system using a zero-pole diagram.

Wakilkan sebuah sistem LTI masa selanjar yang stabil dan kausal dengan menggunakan rajah kutub-sifar.

[4 marks]

[*4 markah*]

CLO1 (b) Solve the inverse Laplace transform of Y(s) to obtain y(t), a right-sided function with the partial fraction expansion method.

Selesaikan Jelmaan Laplace Songsang bagi Y(s) untuk mendapatkan y(t), fungsi sebelah kanan dengan kaedah pengembangan pecahan separa.

$$\mathrm{Y(s)} = \frac{s+3}{s^2+\mathrm{s}}$$

[8 marks]

[*8 markah*]

CLO1 (c) Use the formula of Convolution Sum to obtain the output of the LTI discrete-time system, if the given impulse response is

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

and input signal is

$$\mathrm{x[n]} = \delta[\mathrm{n}] + 2\delta[\mathrm{n}-1] + 2\delta[\mathrm{n}-2].$$

Gunakan persamaan penambahan konvolusi untuk mendapatkan keluaran sistem LTI masa diskrit, jika diberi sambutan dedenyut,

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

dan isyarat masukan,

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

[8 marks]

[*8 markah*]

SECTION B : 40 MARKS

BAHAGIAN B :40 MARKAH

INSTRUCTION:

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

ARAHAN:

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

QUESTION 1

SOALAN 1

CLO1 Mr Haw, a junior engineer, is required to analyse a continuous-time Linear Time-Invariant (LTI) system. The following differential equation describes the causal system with zero initial conditions:

$$y''(t) + 2y'(t) - 3y(t) = x(t).$$

Figure out the transfer function H(s), impulse response h(t) and stability of the system with ROC by applying the Laplace transform and Partial Fraction Expansion method.

Encik Haw, seorang jurutera perlu menganalisa sebuah sistem LTI masa selanjar. Persamaan pembezaan berikut menerangkan sistem kausal dengan keadaan awal sifar:

$$y''(t) + 2y'(t) - 3y(t) = x(t)$$

Tentukan fungsi pindah H(s), sesambut dedenyut h(t) dan kestabilan sistem ini dengan ROC melalui Jelmaan Laplace dan kaedah Pengembangan Pecahan Separa.

[20 marks]

[*20 markah*]

QUESTION 2
SOALAN 2

CLO1 Fourier theory states that any periodic signal can be represented as a combination of basic sinusoidal components that are harmonically related. This combination is expressed through the Fourier series. Using the following Trigonometric Fourier Series form:

$$y(t) = a_0 + \sum_{k=1}^{3} \left(a_k \cos(k\omega t) + b_k \sin(k\omega t) \right)$$

Evaluate the periodic signal shown in Figure B2 and expand it into its Trigonometric Fourier Series form up to $k = 3$.

Teori Fourier menyatakan bahawa setiap isyarat berkala boleh diwakili sebagai gabungan komponen sinusoidal asas yang saling berkait secara harmonik. Gabungan ini dinyatakan melalui Siri Fourier.
Dengan menggunakan bentuk Siri Fourier Trigonometri berikut:

$$y(t) = a_0 + \sum_{k=1}^{3} \left(a_k cos(k\omega t) + b_k sin(k\omega t) \right)$$

Nilaikan isyarat berkala yang ditunjukkan dalam Rajah B2 dan kembangkan ke dalam bentuk Siri Fourier Trigonometri sehingga $k = 3$.

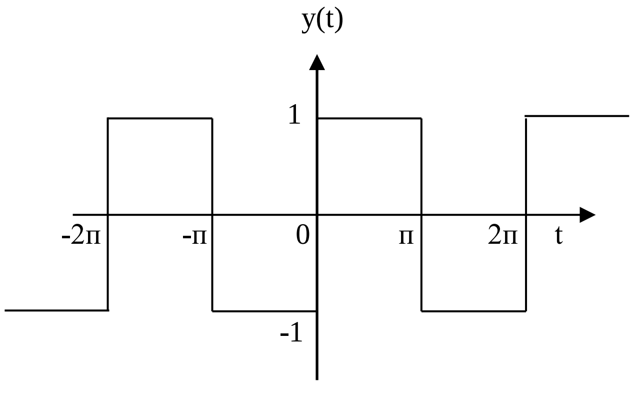

Figure B2 / *Rajah B2*

[20 marks]
[*20 markah*]

SOALAN TAMAT

LAMPIRAN

Appendix 1

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	$\mathrm{u(t)}\cos(at)$	$\frac{s}{s^2+a^2}$
11	$e^{at}\mathrm{u(t)}\sin(bt)$	$\frac{b}{(s-a)^2+b^2}$	14	$e^{at}\mathrm{u(t)}\cos(bt)$	$\frac{s-a}{(s-a)^2+b^2}$
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	$\int_{-\infty}^t f(v)dv$	$\frac{F(s)}{s}+\frac{1}{s}\int_{-\infty}^{0-} f(v)d$

TABLE 3.1(b): LAPLACE TRANSFORM PROPERTIES

		Laplace Tansform X(s)={(f(t)}	
1	Linearity	$\mathrm{ax}_1(t)+bx_2(t)$	$aX_1(z)+bX_2(z)$
2	Time shifting	$\mathrm{x(t-t_0)}$	$e^{-st_0}X(s)$
3	Shifting in s	$e^{-st_0}x(t)$	$X(s{-}s_0)$
4	Time scaling	x(at)	$\frac{1}{\lvert a\rvert}X(s)$
5	Time reversal	x(−t)	X(−s)
6	Differentiation in t	$\frac{dx(t)}{dt}$	$sX(s)$
8	Convolution	$x_1(t)*x_2(t)$	$X[s]X_2[s]$
9	Integration	$\int_{-\infty}^t x(\tau)d\tau$	$\frac{1}{s}X(s)$

Appendix 1

TABLE 3.2(a): COMMON Z- TRANSFORM PAIRS

	$x[n] = Z^{-1}\{X(z)\}$	$X(z) = Z\{x[n]\}$		$x[n] = Z^{-1}\{X(z)\}$	$X(z) = Z\{x[n]\}$
1	$\delta[n]$	1	2	$\delta[n-m]$	z^{-m}
3	$u[n]$	$\frac{z}{z-1} = \frac{1}{1-z^{-1}}$	4	$-u[-n-1]$	$\frac{z}{z-1}$
5	$a^n u[n]$	$\frac{1}{1-az^{-1}} = \frac{z}{z-a}$	6	$-a^n u[-n-1]$	$\frac{1}{1-az^{-1}} = \frac{z}{z-a}$
7	$\mathrm{n}a^n u[n]$	$\frac{az^{-1}}{(1-az^{-1})^2} = \frac{az}{(z-a)^2}$	8	$-\mathrm{n}a^n u[n]$	$\frac{az^{-1}}{(1-az^{-1})^2} = \frac{az}{(z-a)^2}$
9	$(n+1)a^n u[n$	$\frac{1}{(1-az^{-1})^2}$	10	$-\mathrm{n}a^n u[-n-1]$	$\frac{az^{-1}}{(1-az^{-1})^2} = \frac{az}{(z-a)^2}$
11	$[\cos\omega_0 \mathrm{n}]\mathrm{u}(n)$	$\frac{1-[\cos\omega_0]z^{-1}}{1-[2\cos\omega_0]z^{-1}+z^{-2}}$	12	$[\sin\omega_0 \mathrm{n}]\mathrm{u}(n)$	$\frac{1-[\sin\omega_0]z^{-1}}{1-[2\cos\omega_0]z^{-1}+z^{-2}}$
13	$[r^n\cos\omega_0 \mathrm{n}]\mathrm{u}(n)$	$\frac{1-[r\cos\omega_0]z^{-1}}{1-[2r\cos\omega_0]z^{-1}+r^2z^{-2}}$	14	$[r^n\sin\omega_0 \mathrm{n}]\mathrm{u}(n)$	$\frac{[r\sin\omega_0]z^{-1}}{1-[2r\cos\omega_0]z^{-1}+r^2z^{-2}}$
15	$\begin{cases} a^n, 0 \le n \le N - \\ 0, \ Otherwise \end{cases}$	$\frac{1-a^Nz^{-N}}{1-az^{-1}}$			

TABLE 3.2(b): Z- TRANSFORM PROPERTIES

		Z Transform X(z) = Z{x[n]}	
1	Linearity	$\mathrm{a}x_1[n] + bx_2[n]$	$aX_1(z) + bX_2(z)$
2	Time shifting	$\mathrm{x}[\mathrm{n} - n_0]$	$z^{-n_0}X(z)$
3	Time reversal	x[-n]	$X\left(\frac{1}{z}\right)$
4	Multiplication by n	nx[n]	$-z\frac{dX(z)}{dz}$
5	Accumulation	$\sum_{k=-\infty}^{n} x[n]$	$\frac{1}{1-z^{-1}}$
6	Convolution	$x_1[n] * x_2[n]$	$X[z] * X_2[z]$
7	Multiplication by z_0^n	$z_0^n x[n]$	$X\left(\frac{z}{z_0}\right)$
8	Multiplication by $e^{j\Omega n}$	$e^{j\Omega n}X[n]$	$X[e^{j\Omega n}z]$

APPENDIX C

TABLE 4.1(a)FOURIER TRANSFORM PROPERTIES			
		Fourier Transform X(ω)={(f(t)}	
1	Linearity	$ax_1(t) + bx_2(t)$	$aX_1(\omega) + bX_2(\omega)$
2	Time shifting	$x(t - t_0)$	$e^{-j\omega t_0}X(\omega)$
3	Frequency Shifting	$e^{-j\omega t_0}x(t)$	$X(\omega - \omega_0)$
4	Time scaling	$x(at)$	$\frac{1}{\lvert a\rvert}X(\frac{\omega}{a})$
5	Time reversal	$x(-t)$	$X(-\omega)$
6	Differentiation in t	$\frac{d^n x(t)}{dt^n}$	$(j\omega)^n X(\omega)$
7	Differentiation in f	$t^n x(t)$	$(j)^n \frac{d^n}{d\omega^n}X(\omega)$
8	Multiplication by	$x_1(t)x_2(t)$	$\frac{1}{2\pi}X_1(\omega) * X_2(\omega)$
9	Convolution	$x_1(t) * x_2(t)$	$X_1[\omega]X_2[\omega]$
10	Integration	$\int_{-\infty}^{t} x(\tau)d\tau$	$X(0)\delta(\omega) + \frac{1}{2\omega}X(\omega)$

TABLE 4.1(b): COMMON FOURIER TRANSFORM PAIRS		
	Fourier Transform f(t) $\leftrightarrow$X(ω)	
1	$\delta(t)$	1
2	$\delta(t - c)$	$e^{-j\omega c}$, $c\ any\ real\ number$
3	1	$2\pi\delta(\omega)$
4	$-0.5 + u(t)$	$\frac{1}{j\omega}$
5	$u(t)$	$\pi\delta(\omega) + \frac{1}{j\omega}$
6	$e^{-j\omega_0 t}$	$2\pi\delta(\omega - \omega_0), \omega_0\ any\ real\ number$
7	$e^{-bt}u(t)$	$\frac{1}{j\omega + b}$, $b > 0$
8	$cos\omega_0 t$	$\pi[\delta(\omega + \omega_0) + \delta(\omega - \omega_0)]$
9	$cos(\omega_0 t + \theta)$	$\pi[e^{-j\theta}\delta(\omega + \omega_0) + e^{j\theta}\delta(\omega - \omega_0)]$
10	$sin\omega_0 t$	$j\pi[\delta(\omega + \omega_0) - \delta(\omega - \omega_0)]$
11	$sin(\omega_0 t + \theta)$	$j\pi[e^{-j\theta}\delta(\omega + \omega_0) - e^{j\theta}\delta(\omega - \omega_0)]$
12	$Rect(\frac{\tau}{t})$	$\tau sinc\frac{\tau\omega}{2}$
13	$\frac{A}{\pi}\sin(At)$	$Rect(\frac{\omega}{2A})$