SULIT

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

**SESI JUN 2017**

# DEE6122 : SIGNAL AND SYSTEMS

**TARIKH : 29 OKTOBER 2017**
**MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)**

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

Bahagian A: Struktur (4 soalan)
Bahagian B: Esei (2 soalan)

Dokumen sokongan yang disertakan : Jadual Laplace

**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 **4 (FOUR)** structured questions. Answer **ALL** questions.

***ARAHAN:***

*Bahagian ini mengandungi* ***EMPAT (4)*** *soalan berstruktur. Jawab* ***SEMUA*** *soalan.*

**QUESTION 1**

***SOALAN 1***

CLO1
C1

(a) Define an even and odd signal with a graphic representation.

*Takrifkan maksud isyarat genap dan ganjil dengan perwakilan graf.*

[3 marks]

[*3 markah*]

CLO1
C2

(b) Based upon its nature and characteristics of the time domain, the signals may be broadly classified under Continuous-time Signals and Discrete-time Signals. Explain the differences between both signals.

*Berdasarkan keadaan semulajadi dan ciri-ciri pada domain masa, isyarat boleh diklasifikasikan kepada Isyarat masa selanjar dan Isyarat masa diskrit. Terangkan perbezaan antara kedua-dua isyarat tersebut.*

[5 marks]

[*5 markah*]

CLO1 C3

(c) By using discrete-time signals $x_1[n]$ and $x_2[n]$ shown in **Figure A1(c),** sketch each of the following signals by a graph for $y_1 = x_1[n-3]$; $y_2 = 4x_1[n]$ and $y_3 = x_1[n].x_2[n]$.

*Dengan menggunakan isyarat masa diskrit seperti ditunjukkan pada **Rajah A1(c),** lakarkan graf bagi isyarat yang dikehendaki untuk* $y_1 = x_1[n-3]$; $y_2 = 4x_1[n]$ *dan* $y_3 = x_1[n].x_2[n]$.

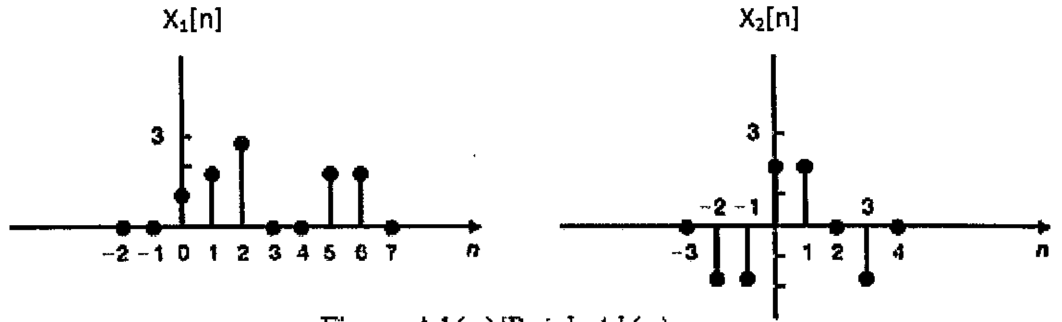


Figure A1(c )/*Rajah A1(c )*

[7 marks]

[*7 markah*]





**QUESTION 2**

***SOALAN 2***

CLO1 C1

(a) State **THREE (3)** convolution sum properties.

*Nyatakan **TIGA (3)** sifat penting dalam kamiran konvolusi.*

[3 marks]

[*3 markah*]

CLO1 C2

(b) In signal processing and analysis, convolution is the most important and fundamental concept. The output of system for any arbitrary input signal could be construct if the impulse response of the system is known by using convolution. Explain the steps of convolution method.

*Dalam pemprosesan dan analisis isyarat, konvolusi adalah konsep asas yang terpenting. Keluaran suatu sistem untuk sebarang masukan arbitrari boleh dibangunkan jika respon denyut sistem tersebut diketahui dengan menggunakan konvolusi. Terangkan langkah-langkah dalam kaedah konvolusi.*

[5 marks]

[*5 markah*]

CLO1 C3

(c) Illustrate the output $y(t) = f1(t) * f2(t)$ of the functions in **Figure A2(c).**

*Illustrasikan keluaran* $y(t) = f1(t) * f2(t)$ *untuk fungsi-fungsi dalam **Rajah A2(c ).***

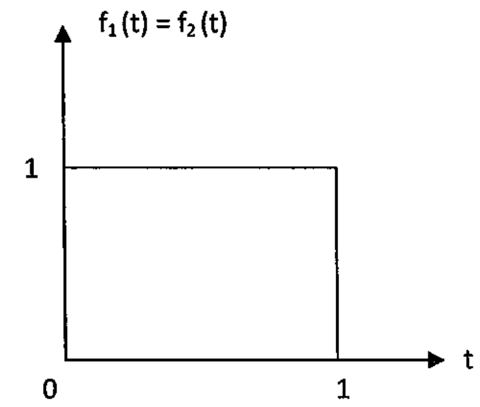


**Figure A2 (c ) / *Rajah A2( c )***

[7 marks]

[*7 markah*]

**QUESTION 3**

***SOALAN 3***

CLO2 C1 (a) Define Laplace Transform for LTI system.

*Takrifkan Jelmaan Laplace untuk sistem LTI.*

[3 marks]
[*3 markah*]

CLO2 C2 (b) Determine the Laplace transform of $e^{at}\,u(t)$ and $\cos \omega_0 t\, u(t)$.

*Tentukan Jelmaan Laplace bagi* $e^{at}\,u(t)$ and $\cos \omega_0 t\, u(t)$.

[5 marks]
[*5 markah*]

CLO2 C3 (c) Calculate the following inverse Laplace Transform of using partial fraction.

*Kirakan Jelmaan Laplace songsang berikut menggunakan pecahan separa.*

$$\frac{7s-6}{s^2-s-6}$$

[7 marks]
[*7 markah*]





**QUESTION 4**

***SOALAN 4***

CLO3 C2 (a) Determine the Fourier Transform of;

*Tentukan Fourier Transform untuk;*

$$x(t) = \cos \omega_0 t$$

[3 marks]
[*3 markah*]

CLO3 C3 (b) Apply the complex exponential Fourier series representation for function below;

*Aplikasikan persembahan semula bagi fourier siri eksponen komplek bagi persamaan di bawah;*

$$x(t) = \cos 6t + \sin 8t$$

[5 marks]
[*5 markah*]

CLO3 C4 (c) Consider an ideal low-pass filter with frequency response as below:

$$H(\omega) = \begin{cases} 1 & |\omega| < \omega_c \\ 0 & |\omega| > \omega_c \end{cases}$$

Analyze the output of the filter if the input is $x(t) = \dfrac{\sin at}{\pi t}$ by determine the output y(t) for $a < \omega_c$ and $a > \omega_c$.

*Dengan menganggap sebuah penapis low-pass dengan freuquensi seperti di bawah:*

$$H(\omega) = \begin{cases} 1 & |\omega| < \omega_c \\ 0 & |\omega| > \omega_c \end{cases}$$

*Analisa keluaran penapis low-pass tersebut jika input* $x(t) = \dfrac{\sin at}{\pi t}$ *untuk y(t) for* $a < \omega_c$ *and* $a > \omega_c$.

[7 marks]
[*7 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***

CLO2 C3

Calculate the z-transform *X(z)* and sketch the pole-zero plot with ROC for

$$x[n]=\left(\frac{1}{2}\right)^n u[n]+\left(\frac{1}{3}\right)^n u[n] \text{ and } x[n]=\left(\frac{1}{3}\right)^n u[n]+\left(\frac{1}{2}\right)^n u[-n-1].$$

*Kirakan Jelmaan Z dan lakarkan plot kutub-sifar dengan ROC bagi*

$$x[n]=\left(\frac{1}{2}\right)^n u[n]+\left(\frac{1}{3}\right)^n u[n] \text{ dan } x[n]=\left(\frac{1}{3}\right)^n u[n]+\left(\frac{1}{2}\right)^n u[-n-1].$$

[20 marks]

[*20 markah*]





**QUESTION 2**

***SOALAN 2***

CLO3 C4

Solve the problem of sequence of $x[n]=\sum_{k=-\infty}^{\infty}\delta[n-4k]$ by sketching the x[n] and calculate the Fourier coefficients $c_k$ of x[n] and sketch the $c_k$.

*Selesaikan masalah yang melibatkan turutan* $x[n]=\sum_{k=-\infty}^{\infty}\delta[n-4k]$ *dengan melakarkan x[n] dan kirakan koefisien* $c_k$ *dari x[n] dan lakarkan juga* $c_k$.

[20 marks]

[*20 markah*]

**SOALAN TAMAT**

**Table : Some Laplace Transform Pairs**

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



**Table : Common Fourier Transforms Pairs**

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

## Energy and Power of Signal

$$E_x = \int_{-T/2}^{T/2} x(t)x^*(t)dt = \int_{-T/2}^{T/2} |x(t)|^2\, dt$$

$$P_x = \frac{1}{T}\int_{-T/2}^{T/2} x(t)x^*(t)dt = \frac{1}{T}\int_{-T/2}^{T/2} |x(t)|^2\, dt = \frac{1}{T}E_x$$

## Trigonometric of Signal in terms of Complex Exponential of Signal

$$x(t) = \cos\omega_1 t = \frac{e^{j\omega_1 t} + e^{-j\omega_1 t}}{2}$$

$$x(t) = \sin\omega_1 t = \frac{e^{j\omega_1 t} - e^{-j\omega_1 t}}{2j}$$

## Complex Exponential Fourier Series

$$f(t) = \sum_{n=-\infty}^{\infty} C_n\, e^{jn\omega t} \qquad C_n = \frac{1}{T}\int_0^T f(t)e^{-jn\omega t}dt$$

$$\int \cos at\,dt = \frac{1}{a}\sin at$$

$$\int \sin at\,dt = -\frac{1}{a}\cos at$$

$$\int t\cos at\,dt = \frac{1}{a^2}\cos at + \frac{1}{a}t\sin at$$

$$\int t\sin at\,dt = \frac{1}{a^2}\sin at - \frac{1}{a}t\cos at$$

$$\int e^{-at}dt = \frac{e^{-at}}{-a}$$