
UNIVERSITI SAINS MALAYSIA

First Semester Examination
2012/2013 Academic Session

January 2013

EEE 228 – SIGNAL AND SYSTEM
[ISYARAT DAN SISTEM]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of THIRTEEN (13) pages including Appendices TWELVE (12) of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi TIGA BELAS (13) mukasurat beserta Lampiran DUA BELAS (12) muka surat bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: This question paper consists SIX (6) questions. Answer **FIVE** (5) questions. All questions carry the same marks.

[Arahan: Kertas soalan ini mengandungi ENAM (6) soalan. Jawab **LIMA** (5) soalan. Semua soalan membawa jumlah markah yang sama.]

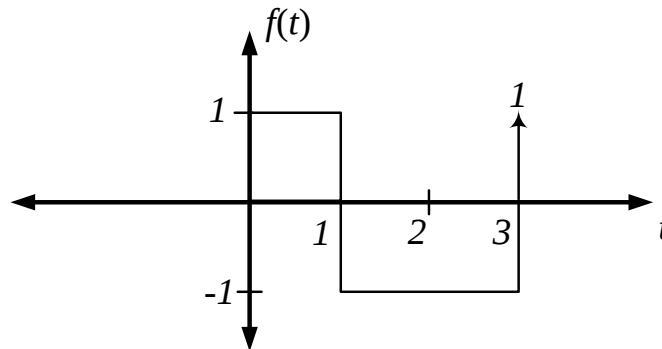
Answer to any question must start on a new page.

[Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru]

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

1. (a) Isyarat $f(t)$ yang ditunjukkan dalam Rajah 1(a).
Signal $f(t)$ is shown in Figure 1(a).



Rajah 1(a)

Figure 1(a)

- (i) Tuliskan persamaan $f(t)$ dari segi **fungsi langkah unit dan fungsi delta**.

*Write the equation of $f(t)$ in terms of **unit step function and delta function**.*

(15 markah/marks)

- (ii) Cari dan lakarkan $\int_{-\infty}^t f(t-2)dt$ untuk isyarat $f(t)$.

Find and sketch $\int_{-\infty}^t f(t-2)dt$ for the signal $f(t)$.

Pembayang:

Hints:

$$\int_{-\infty}^t u(\tau) d\tau = r(t)$$

$$\frac{d}{dt}[u(t)] = \delta(t)$$

(25 markah/marks)

...3/-

- (b) Tentukan sama ada isyarat $x[n] = (-1)^{n^2}$ adalah berkala. Jika isyarat $x[n]$ berkala kemudian cari tempoh asas $x[n]$.

Determine the condition for the signal $x[n] = (-1)^{n^2}$ to be periodic. If signal $x[n]$ is periodic then find the fundamental period of $x[n]$.

(20 markah/marks)

- (c) Tentukan samaada isyarat berikut adalah isyarat tenaga atau kuasa isyarat atau tidak kedua-duanya.

Determine whether the following signal is energy signal or power signal or neither.

$$\begin{aligned}x(t) &= A && \text{for } t < 0 \\&= Ae^{-at} && \text{for } t \geq 0 \\&\text{Where } a > 0\end{aligned}$$

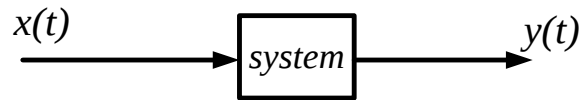
(20 markah/marks)

- (d) Nilaikan kamiran berikut
Evaluate the following integral

$$\int_{-4}^4 (t-2)^2 \delta'(2t-2) dt$$

(20 markah/marks)

2. (a)



Tentukan sifat-sifat berikut untuk sistem $y(t) = \cos(t+2)x(t-2)$

Determine the following properties for the system $y(t) = \cos(t+2)x(t-2)$

(i) punca

causality

(ii) ingatan

memory

(iii) masa-variants

time-variance

(30 markah/marks)

(b) Input $x(t)$ dan sambutan dedenyut $h(t)$ bagi sistem LTI berterusan diberikan oleh $x(t) = e^{-at}u(t)$, bagi $a > 0$ dan $h(t) = u(t)$. Apakah output, $y(t)$?

The input $x(t)$ and the impulse response $h(t)$ of a continuous LTI system are given by $x(t) = e^{-at}u(t)$, for $a > 0$ and $h(t) = u(t)$. What is the output, $y(t)$?

(30 markah/marks)

- (c) Satu sistem adalah yang dinyatakan oleh persamaan pembezaan berikut
A system is described by the following differential equation

$$\frac{d^2 y(t)}{dt^2} + 3 \frac{dx(t)}{dt} + 2y(t) = \frac{dx(t)}{dt} - x(t)$$

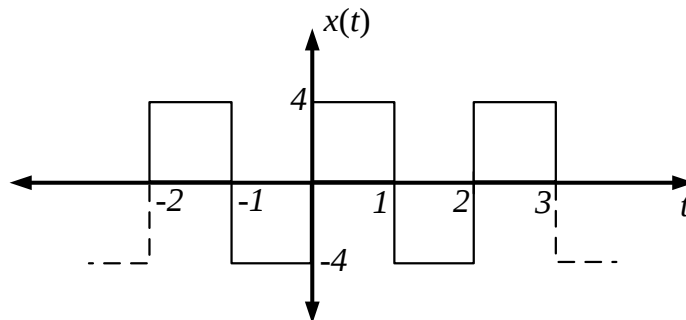
Cari Impulse Sambutan $h(t)$ bagi sistem

Find the Impulse Response $h(t)$ of the system

(40 markah/marks)

3. (a) Cari eksponen siri Fourier bagi isyarat $x(t)$ yang ditunjukkan dalam Rajah 3(a).
Find the exponential Fourier series for the signal $x(t)$ shown in Figure 3(a).

(40 markah/marks)

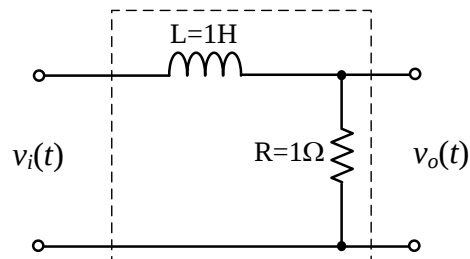


Rajah 3(a)

Figure 3(a)

- (b) Cari voltan keluaran $v_o(t)$ litar yang ditunjukkan dalam Rajah 3(b) untuk voltan input berkala $v_i(t)$, di mana $v_i(t) = 4 \cos(t) - 2 \cos(2t)$

Find the output voltage $v_o(t)$ of the circuit shown in Figure 3(b) for a periodic input voltage $v_i(t)$, where $v_i(t) = 4 \cos(t) - 2 \cos(2t)$



Rajah 3(b)

Figure 3(b)

(40 markah/marks)

- (c) Gunakan teorem Parseval untuk mencari jumlah kuasa isyarat berkala

Apply Parseval's theorem to find the amount of power of the periodic signal

$$x(t) = 3 + 5 \cos(2t + 30^\circ) + 2 \cos(4t + 40^\circ)$$

(20 markah/marks)

4. (a) Dengan menggunakan definisi Jelmaan Fourier, cari jelmaan Fourier bagi isyarat–isyarat berikut:

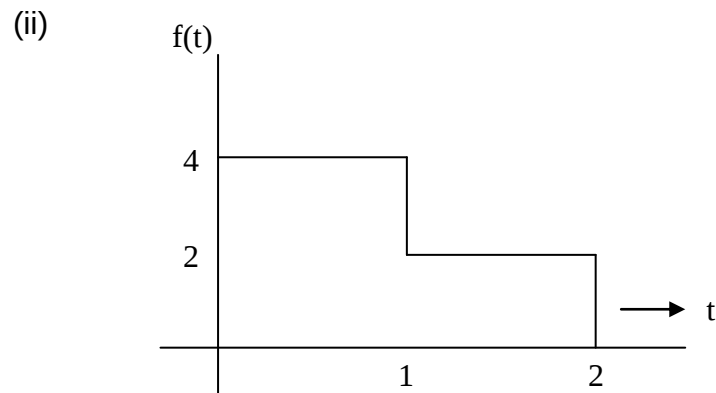
Using the definition of Fourier Transform, find the Fourier Transform of these signals:

(i) $x(t) = \sin \omega_0 t$

*Diberi

*Given

$$FT \left\{ \frac{e^{-j\omega_0 t}}{2\pi} \right\} = \delta(\omega - \omega_0)$$



Rajah 4(a)

Figure 4(a)

(30 markah/marks)

...8/-

- (b) Diberi dua isyarat iaitu;
Given two signals which are;

$$g_1(t) = 2 \cos(200\pi t) \quad g_2(t) = 5 \cos(1000\pi t)$$

Hasil gandaan kedua-dua isyarat ini diberi sebagai;
The multiplication of these two signals is given by;

$$g_3(t) = g_1(t)g_2(t)$$

Dengan menggunakan ciri-ciri Jelmaan Fourier, cari :
By using appropriate properties of Fourier Transform, find:

- (i) Jelmaan bagi $g_3(t)$
The Fourier Transform of $g_3(t)$
- (ii) Lakarkan spektrum frekuensi $g_3(t)$.
Sketch the frequency spectrum of $g_3(t)$

(35 markah /marks)

- (c) Pertimbangkan isyarat analog berikut:
Consider the analog signal:

$$x(t) = 5 \cos(50\pi t) + 2 \sin(200\pi t) - 2 \cos(100\pi t)$$

- (i) Tentukan nilai minimum frekuensi persampelan dan versi isyarat analog yang telah tersampel pada frekuensi tersebut.

Determine the minimum sampling frequency and the sampled version of analog signal at this frequency.

- (ii) Lakarkan dan tunjukkan titik persampelan bagi setiap komponen isyarat analog.

Sketch and show the sampling points of each waveform analog components.

(35 markah /marks)

5. (a) Dengan menggunakan rajah, diagram dan persamaan-persamaan yang bersesuaian, terangkan:

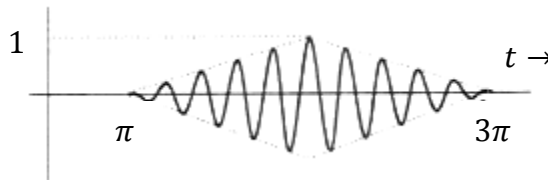
Using appropriate illustration, diagram and equations, describe:

- (i) Kepentingan proses modulasi dalam proses transmisi data
The importance of modulation process in data transmission

- (ii) Proses modulasi dan demodulasi
The modulation and demodulation process

(30 markah/marks)

- (b) Isyarat dalam Rajah 5(b) ialah isyarat termodulat dengan pembawa $\cos 20t$.
Signal in Fig. 5(b) is a modulated signal with carrier $\cos 20t$.



Rajah 5(b)

Figure 5(b)

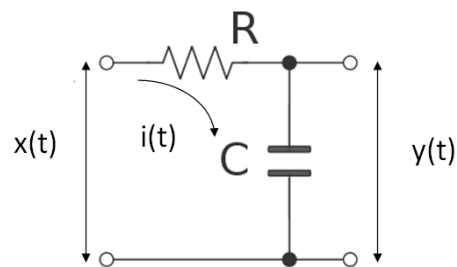
- (i) Cari Jelmaan Fourier bagi isyarat termodulat seperti dalam Rajah 5(b).

Find the Fourier Transform for the modulated signal as illustrated in Figure 5(b)

- (ii) Lakarkan spektra amplitud dan fasa bagi isyarat termodulat tersebut.
Sketch the amplitude and phase spectra for the modulated signal.

(30 markah/marks)

- (c) Merujuk kepada litar RC mudah dalam Rajah 5(c):
Refer to a simple RC circuit as in Figure 5(c):



Rajah 5(c)

Figure 5(c)

Terbitkan dan buktikan bahawa persamaan asas bagi litar tersebut yang melibatkan $x(t)$ dan $y(t)$ diberi seperti berikut:

Derive and prove that the equation which relates $x(t)$ and $y(t)$ is as below:

$$\frac{dy(t)}{dt} + \frac{1}{RC}y(t) = \frac{1}{RC}x(t)$$

Dengan menggunakan Fourier Transform bagi persamaan di atas, tentukan:

By applying Fourier Transform to the above equation, determine:

- (i) Frekuensi sambutan, $H(\omega)$
The frequency response, $H(\omega)$
- (ii) Amplitud sambutan
The amplitude response
- (iii) The phase response
Fasa sambutan

(40 markah/marks)

6. (a) (i) Cari jelmaan-Z bagi isyarat

Find the Z-transform of the signal

$$x(n) = \left(\frac{1}{2}\right)^n u(n) * \left(\frac{1}{3}\right)^n u(n)$$

(15 markah /marks)

- (ii) Diberi fungsi seperti berikut,

Given a function as below,

$$X(z) = \frac{3 + 2z^{-1} + z^{-2}}{1 - 3z^{-1} + 2z^{-2}}$$

Cari jelmaan-Z songsang fungsi tersebut dan dapatkan empat ungkapan pertama bagi $x[n]$

Find the inverse Z-transform of the function using a power series expansion and find the first four terms of $x[n]$

(20 markah /marks)

- (b) Dengan menggunakan jelmaan Z, tentukan sambutan sistem LTI dengan sambutan impuls $h(n) = 0.4^n u(n)$, dengan masukan, $x(n) = 0.2^n u(n)$.

Using Z-transform, determine the response of the LTI system with impulse response $h(n) = 0.4^n u(n)$, for an input $x(n) = 0.2^n u(n)$.

(25 markah /marks)

- (c) Tentukan 4 titik DFT dan IDFT bagi isyarat berikut:

Determine the 4-point DFT and IDFT of the given signal:

$$x(n) = \begin{cases} 1 & 0 \leq n \leq 3 \\ 0 & \text{lain - lain/elsewhere} \end{cases}$$

Diberi:

Given:

$$F_r = \sum_{k=0}^{N-1} f_k e^{-jr\Omega k}$$

$$f_k = \frac{1}{N} \sum_{r=0}^{N-1} F_r e^{jr\Omega k}$$

(40 markah /marks)

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