UNIVERSITI SAINS MALAYSIA

Peperiksaan Kursus Semasa Cuti Panjang
Sidang Akademik 2007/2008

Jun 2008

EEE 208 – TEORI LITAR II

Masa: 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi SEMBILAN muka surat dan EMPAT muka surat LAMPIRAN yang bercetak sebelum anda memulakan peperiksaan ini.

Kertas soalan ini mengandungi ENAM soalan.

Jawab LIMA soalan.

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Agihan markah bagi setiap soalan diberikan di sudut sebelah kanan soalan berkenaan.

Jawab semua soalan dalam bahasa Malaysia atau bahasa Inggeris atau kombinasi kedua-duanya.

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1. (a) Berdasarkan Rajah 1(a), dapatkan:

Based on Figure 1(a), calculate:

(i) Arus Sumber, I_1

The source current, I_1

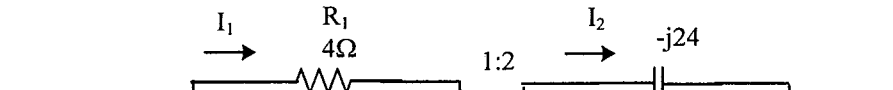
(ii) Voltan keluaran, V_o

The output voltage, V_o

(iii) Kuasa komplek yang dibekalkan oleh sumber

The complex power supplied by the source

Andaikan pengubah adalah pengubah ideal.
Assume that the transformer is an ideal transformer.



Rajah 1(a)
Figure 1(a)

(60%)

(b) Berdasarkan Rajah 1(b), tentukan nilai pekali gandingan dan tenaga yang disimpan oleh induktor-induktor terganding pada masa t = 2.0s.

Based on Figure 1(b), determine the coupling coefficient and the energy stored in the coupled inductors at t = 2.0s.

(40%)

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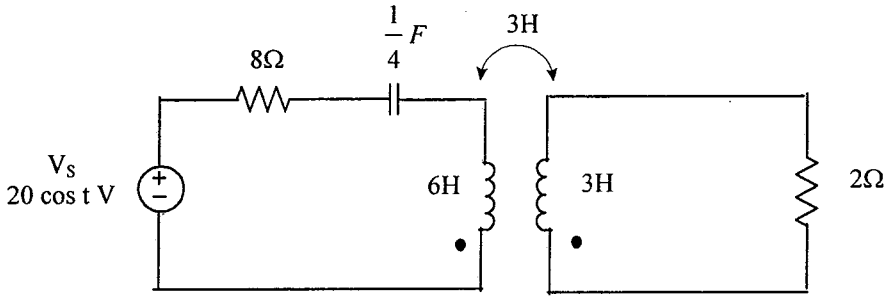
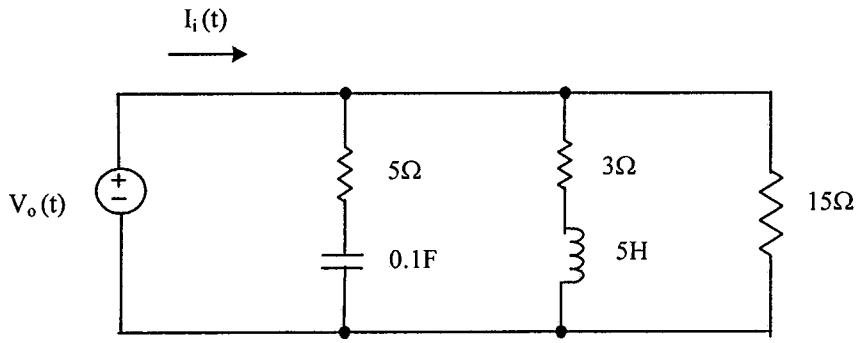


Rajah 1(b)
Figure 1(b)

2. (a) Dapatkan fungsi pindah $V_o(\omega)/I_i(\omega)$ untuk litar dalam Rajah 2. Dapatkan sifar-sifar dan kutub-kutubnya.

Find the transfer function $V_o(\omega)/I_i(\omega)$ for the circuit in Figure 2. Obtain its zeros and poles.

(50%)



Rajah 2
Figure 2

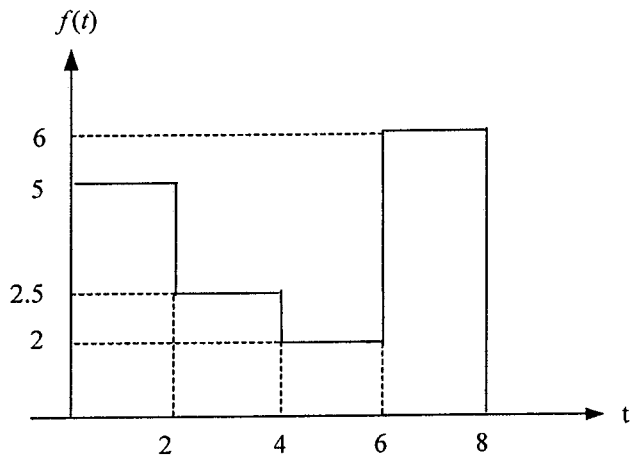
(b) Satu litar saluran selari resonan terdiri dari $R = 1M\Omega$, $L = 0.2H$ dan $C = 0.5nF$. Dapatkan nilai ω_o, ω_1, ω_2, Q dan B.

A parallel resonant circuit has $R = 1M\Omega$, $L = 0.2H$ and $C = 0.5nF$. Calculate ω_o, ω_1, ω_2, Q and B.

(50%)

3. (a) Dapatkan jelmaan Laplace bagi $f(t)$ dalam Rajah 3(a).

Obtain the Laplace transform of $f(t)$ in Figure 3(a).



Rajah 3(a)
Figure 3(a)

(i) Menggunakan pengamiran.
By integration.

(ii) Menggunakan jadual dan teori-teori.
Using table and theorem.

(20%)

(b) Menggunakan jelmaan Laplace kepada litar dalam Rajah 3(b), tentukan:

By using Laplace transform to the circuit in Figure 3(b), find:

(i) Fungsi pindah $H(s) = V_o(s)/V_i(s)$

The transfer function $H(s) = V_o(s)/V_i(s)$

(ii) Sambutan dedenyut

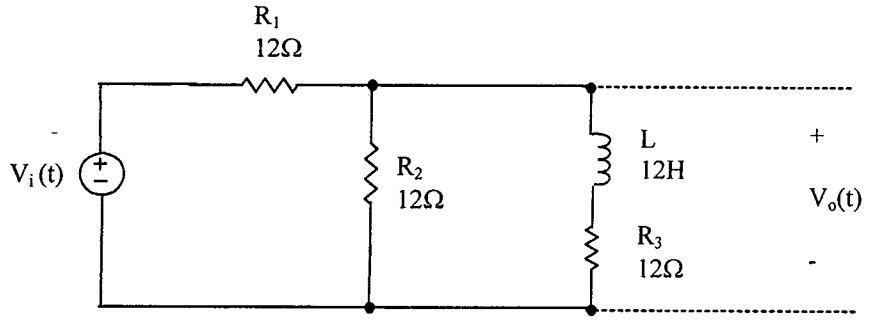
The impulse response

(iii) $V_o(t)$ *jika* $V_i(t) = u(t)$

$V_o(t)$ *if* $V_i(t) = u(t)$

(iv) $V_o(t)$ *jika* $V_i(t) = 40\sin 10\,t\ V$

$V_o(t)$ *if* $V_i(t) = 40\sin 10\,t\ V$



Rajah 3(b)
Figure 3(b)

(80%)

4. (a) Tentukan samaada fungsi-fungsi berikut berkala atau tidak. Jika berkala, dapatkan kalaan/tempoh untuk fungsi tersebut.

Determine whether the following functions are periodic or not. If periodic, find its period.

(i) $f(t) = \cos \pi t + 2\cos 5\pi t + 7\cos 10\pi t$

(ii) $g(t) = \cos 2\pi t - \sin 4\pi t$

(iii) $h(t) = \pi t$

(iv) $i(t) = 2.9\cos(4\pi t + 100^\circ) + 29\cos(6\pi t + 23^\circ)$

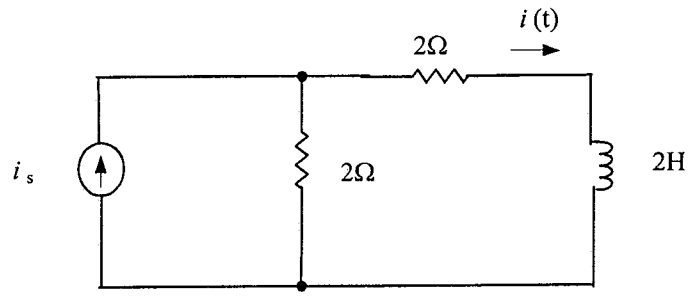
(v) $j(t) = \sin 4t \cos 2t$

(vi) $k(t) = \sin 4\pi t + \cos 4t$ (30%)

(b) Dapatkan $i(t)$ dalam litar Rajah 4(a). Juga anggarkan kuasa purata yang dibekalkan kepada litar menggunakan teori Parseval sehingga harmonik ke-4. Diberikan:

Find $i(t)$ in the circuit of Figure 4(a). Also, approximate the average power supplied to the circuit using Parseval's theorem up to the 4th harmonic. Given that:

$$i_s(t) = 1 + \sum_{n=1}^{\infty} \frac{4}{n^2} \cos nt$$



Rajah 4(a)
Figure 4(a)

(40%)

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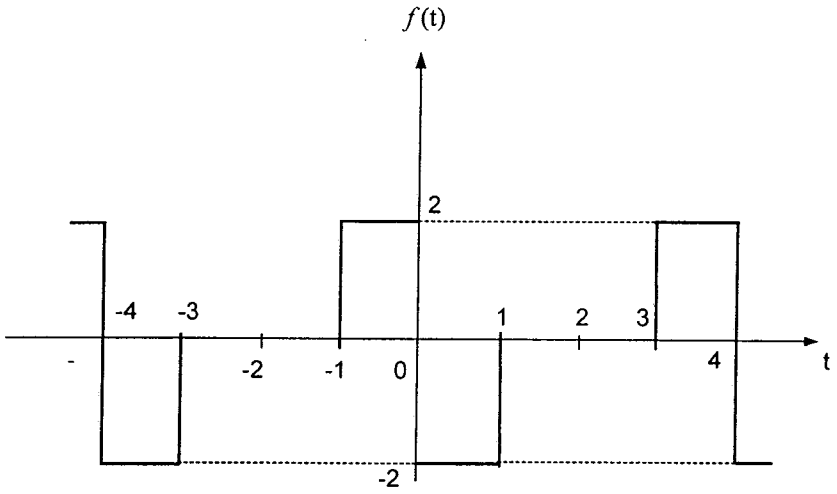
(c) Dapatkan siri Fourier untuk gelombang berkala berikut:

Find the Fourier series for the following periodic waveform.

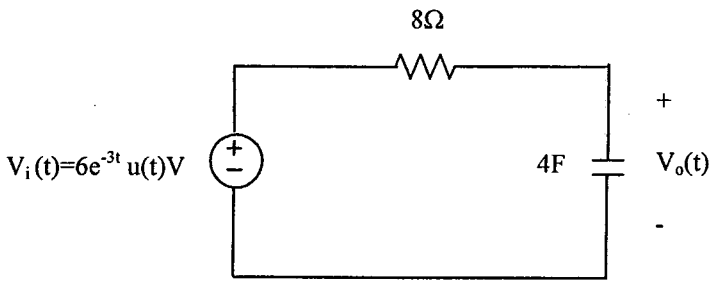


Rajah 4(b)
Figure 4(b)

(30%)

5. (a) Menggunakan kaedah jelmaan Fourier, dapatkan $v_o(t)$ dalam litar Rajah 5(a).

Use the Fourier transform method to obtain $v_o(t)$ in the circuit of Figure 5(a).



Rajah 5(a)
Figure 5(a)

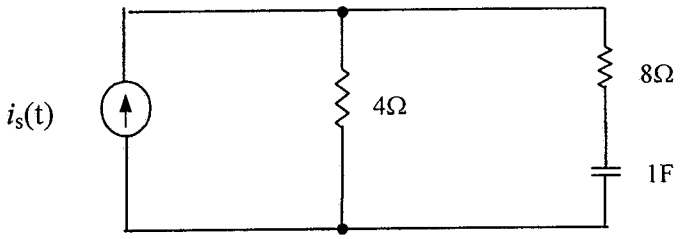
(50%)

...8/-

(b) Menggunakan kaedah jelmaan Fourier, dapatkan $i_o(t)$ dalam litar Rajah 5(b).

Use the Fourier transform method to obtain $i_o(t)$ in the circuit of Figure 5(b).

$$i_s(t) = 20 \sin 4t \text{ A}$$



Rajah 5(b)
Figure 5(b)

(50%)

6. Berdasarkan jaringan dalam Rajah 6, dapatkan:

Based on the network shown in Figure 6, determine:

(i) Parameter z
z parameters (25%)

(ii) Parameter y
y parameters (15%)

(iii) Parameter h
h parameters (15%)

...9/-

(iv) Parameter g

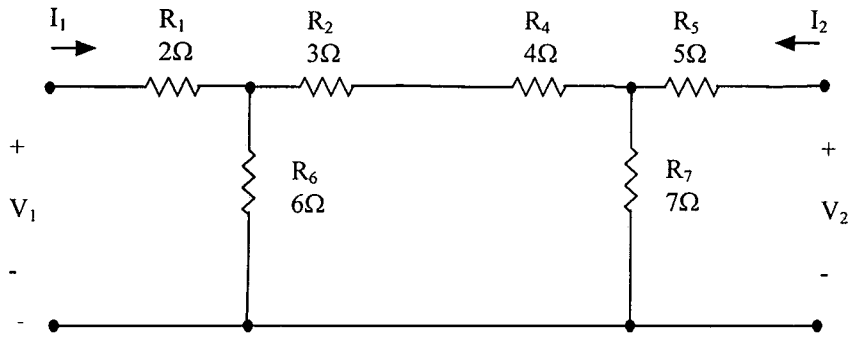
g parameters (15%)

(v) Parameter T

T parameters (15%)

(vi) Parameter t

t parameters (15%)



Rajah 6
Figure 6

oooOooo

TABLE 1: PROPERTIES OF THE LAPLACE TRANSFORM

Property	$f(t)$	$F(s)$
Linearity	$a_1 f_1(t) + a_2 f_2(t)$	$a_1 F_1(s) + a_2 F_2(s)$
Scaling	$f(at)$	$\frac{1}{a} F\left(\frac{s}{a}\right)$
Time shift	$f(t-a)u(t-a)$	$e^{-as}F(s)$
Frequency shift	$e^{-at}f(t)$	$F(s+a)$
Time differentiation	$\frac{df}{dt}$	$sF(s) - f(0^-)$
	$\frac{d^2 f}{dt^2}$	$s^2F(s) - sf(0^-) - f'(0^-)$
	$\frac{d^3 f}{dt^3}$	$s^3F(s) - s^2 f(0^-) - sf'(0^-) - f''(0^-)$
	$\frac{d^n f}{dt^n}$	$s^nF(s) - s^{n-1}f(0^-) - s^{n-2}f'(0^-) - \cdots - f^{(n-1)}(0^-)$
Time integration	$\int_0^t f(t)\,dt$	$\frac{1}{s}F(s)$
Frequency differentiation	$tf(t)$	$-\frac{d}{ds}F(s)$
Frequency integration	$\frac{f(t)}{t}$	$\int_s^\infty F(s)\,ds$
Time periodicity	$f(t) = f(t+nT)$	$\frac{F_1(s)}{1-e^{-sT}}$
Initial value	$f(0^+)$	$\lim_{s\to\infty} sF(s)$
Final value	$f(\infty)$	$\lim_{s\to 0} sF(s)$
Convolution	$f_1(t) * f_1(t)$	$F_1(s)F_2(s)$

JADUAL PENGUBAHAN PARAMETER-PARAMETER RANGKAIAN DUA PENGKALAN

Two port parameters conversion table

	z		y		h		g		T		t	
z	z_{11}	z_{12}	$\frac{y_{22}}{\Delta_y}$	$-\frac{y_{12}}{\Delta_y}$	$\frac{\Delta_h}{h_{22}}$	$\frac{h_{12}}{h_{22}}$	$\frac{1}{g_{11}}$	$-\frac{g_{12}}{g_{11}}$	$\frac{A}{C}$	$\frac{\Delta_T}{C}$	$\frac{d}{c}$	$\frac{1}{c}$
	z_{21}	z_{22}	$-\frac{y_{21}}{\Delta_y}$	$\frac{y_{11}}{\Delta_y}$	$-\frac{h_{21}}{h_{22}}$	$\frac{1}{h_{22}}$	$\frac{g_{21}}{g_{11}}$	$\frac{\Delta_g}{g_{11}}$	$\frac{1}{C}$	$\frac{D}{C}$	$\frac{\Delta_t}{c}$	$\frac{a}{c}$
y	$\frac{z_{22}}{\Delta_z}$	$-\frac{z_{12}}{\Delta_z}$	y_{11}	y_{12}	$\frac{1}{h_{11}}$	$-\frac{h_{12}}{h_{11}}$	$\frac{\Delta_g}{g_{22}}$	$\frac{g_{12}}{g_{22}}$	$\frac{D}{B}$	$-\frac{\Delta_T}{B}$	$\frac{b}{b}$	$\frac{1}{b}$
	$-\frac{z_{21}}{\Delta_z}$	$\frac{z_{11}}{\Delta_z}$	y_{21}	y_{22}	$\frac{h_{21}}{h_{11}}$	$\frac{\Delta_h}{h_{11}}$	$-\frac{g_{21}}{g_{22}}$	$\frac{1}{g_{22}}$	$\frac{1}{B}$	$\frac{A}{B}$	$-\frac{\Delta_t}{b}$	$\frac{d}{b}$
h	$\frac{\Delta_z}{z_{22}}$	$\frac{z_{12}}{z_{22}}$	$\frac{1}{y_{11}}$	$-\frac{y_{12}}{y_{11}}$	h_{11}	h_{12}	$\frac{g_{22}}{\Delta_g}$	$-\frac{g_{12}}{\Delta_g}$	$\frac{B}{D}$	$\frac{\Delta_T}{D}$	$\frac{b}{a}$	$\frac{1}{a}$
	$-\frac{z_{21}}{z_{22}}$	$\frac{1}{z_{22}}$	$\frac{y_{21}}{y_{11}}$	$\frac{\Delta_y}{y_{11}}$	h_{21}	h_{22}	$-\frac{g_{21}}{\Delta_g}$	$\frac{g_{11}}{\Delta_g}$	$\frac{1}{D}$	$\frac{C}{D}$	$\frac{\Delta_t}{a}$	$\frac{c}{a}$
g	$\frac{1}{z_{11}}$	$-\frac{z_{12}}{z_{11}}$	$\frac{\Delta_y}{y_{22}}$	$\frac{y_{12}}{y_{22}}$	$\frac{h_{22}}{\Delta_h}$	$-\frac{h_{12}}{\Delta_h}$	g_{11}	g_{12}	$\frac{C}{A}$	$-\frac{\Delta_T}{A}$	$\frac{c}{d}$	$-\frac{1}{d}$
	$\frac{z_{21}}{z_{11}}$	$\frac{\Delta_z}{z_{11}}$	$-\frac{y_{21}}{y_{22}}$	$\frac{1}{y_{22}}$	$-\frac{h_{21}}{\Delta_h}$	$\frac{h_{11}}{\Delta_h}$	g_{21}	g_{22}	$\frac{1}{A}$	$\frac{B}{A}$	$\frac{\Delta_t}{d}$	$\frac{b}{d}$
T	$\frac{z_{11}}{z_{21}}$	$\frac{\Delta_z}{z_{21}}$	$-\frac{y_{22}}{y_{21}}$	$-\frac{1}{y_{21}}$	$-\frac{\Delta_h}{h_{21}}$	$-\frac{h_{11}}{h_{21}}$	$\frac{1}{g_{21}}$	$\frac{g_{22}}{g_{21}}$	A	B	$\frac{d}{\Delta_t}$	$\frac{b}{\Delta_t}$
	$\frac{1}{z_{21}}$	$\frac{z_{22}}{z_{21}}$	$-\frac{\Delta_y}{y_{21}}$	$-\frac{y_{11}}{y_{21}}$	$-\frac{h_{22}}{h_{21}}$	$-\frac{1}{h_{21}}$	$\frac{g_{11}}{g_{21}}$	$\frac{\Delta_g}{g_{21}}$	C	D	$\frac{c}{\Delta_t}$	$\frac{a}{\Delta_t}$
t	$\frac{z_{22}}{z_{12}}$	$\frac{\Delta_z}{z_{12}}$	$-\frac{y_{11}}{y_{12}}$	$-\frac{1}{y_{12}}$	$\frac{1}{h_{12}}$	$\frac{h_{11}}{h_{12}}$	$-\frac{\Delta_g}{g_{12}}$	$-\frac{g_{22}}{g_{12}}$	$\frac{D}{\Delta_T}$	$\frac{B}{\Delta_T}$	a	b
	$\frac{1}{z_{12}}$	$\frac{z_{11}}{z_{12}}$	$-\frac{\Delta_y}{y_{12}}$	$-\frac{y_{22}}{y_{12}}$	$\frac{h_{22}}{h_{12}}$	$\frac{\Delta_h}{h_{12}}$	$-\frac{g_{11}}{g_{12}}$	$-\frac{1}{g_{12}}$	$\frac{C}{\Delta_T}$	$\frac{A}{\Delta_T}$	c	d

$\Delta_z = z_{11}z_{22} - z_{12}z_{21}$, $\Delta_h = h_{11}h_{22} - h_{12}h_{21}$, $\Delta_T = AD - BC$

$\Delta_y = y_{11}y_{22} - y_{12}y_{21}$, $\Delta_g = g_{11}g_{22} - g_{12}g_{21}$, $\Delta_t = ad - bc$

TABLE 2: LAPLACE TRANSFORM PAIRS

$f(t)$	$F(s)$
$\delta(t)$	1
$u(t)$	$\frac{1}{s}$
e^{-at}	$\frac{1}{s+a}$
t	$\frac{1}{s^2}$
t^n	$\frac{n!}{s^{n+1}}$
te^{-at}	$\frac{1}{(s+a)^2}$
$t^n e^{-at}$	$\frac{n!}{(s+a)^{n+1}}$
$\sin \omega t$	$\frac{\omega}{s^2+\omega^2}$
$\cos \omega t$	$\frac{s}{s^2+\omega^2}$
$\sin(\omega t+\theta)$	$\frac{s \sin\theta + \omega \cos\theta}{s^2+\omega^2}$
$\cos(\omega t+\theta)$	$\frac{s \cos\theta - \omega \sin\theta}{s^2+\omega^2}$
$e^{-at} \sin \omega t$	$\frac{\omega}{(s+a)^2+\omega^2}$
$e^{-at} \cos \omega t$	$\frac{s+a}{(s+a)^2+\omega^2}$

*Defined for $t \geq 0$, $f(t) = 0$ for $t < 0$.

Fourier Transform Pairs

$f(t)$	$F(\omega)$
$\delta(t)$	1
1	$2\pi\delta(\omega)$
$\lvert t\rvert$	$-\frac{2}{\omega^2}$
$e^{-at}u(t)$	$\frac{1}{a+j\omega}$
$e^{at}u(-t)$	$\frac{1}{a-j\omega}$
$t^n e^{-at}u(t)$	$\frac{n!}{(a+j\omega)^{n+1}}$
$e^{-a\lvert t\rvert}$	$\frac{2}{a^2+\omega^2}$
$e^{j\omega_0 t}$	$2\pi\delta(\omega-\omega_0)$
$\sin\omega_0 t$	$j\pi[\delta(\omega+\omega_0)-\delta(\omega-\omega_0)]$
$\cos\omega_0 t$	$\pi[\delta(\omega+\omega_0)+\delta(\omega-\omega_0)]$
$e^{-at}u(t)\sin\omega_0 t$	$\frac{\omega_0}{(a+j\omega)^2+\omega_0^2}$
$e^{-at}u(t)\cos\omega_0 t$	$\frac{a+j\omega}{(a+j\omega)^2+\omega_0^2}$