UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2007/2008

October/November 2007

EEE 208 – CIRCUIT THEORY II
[Teori Litar II]

Duration: 3 hours
[Masa: 3 jam]

Please check that this examination paper consists of NINE pages of printed material and FOUR pages APPENDIX before you begin the examination.

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

This paper contains SIX questions.

[Kertas soalan ini mengandungi ENAM soalan].

Instructions: Answer **FIVE** (5) questions. If a candidate answer more than five questions, only the first five answered will be examined and awarded marks.

[Arahan: *Jawab* ***LIMA*** *soalan. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah].*

Answer to any question must start on a new page.

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

You may answer a question either in bahasa Malaysia or in English.

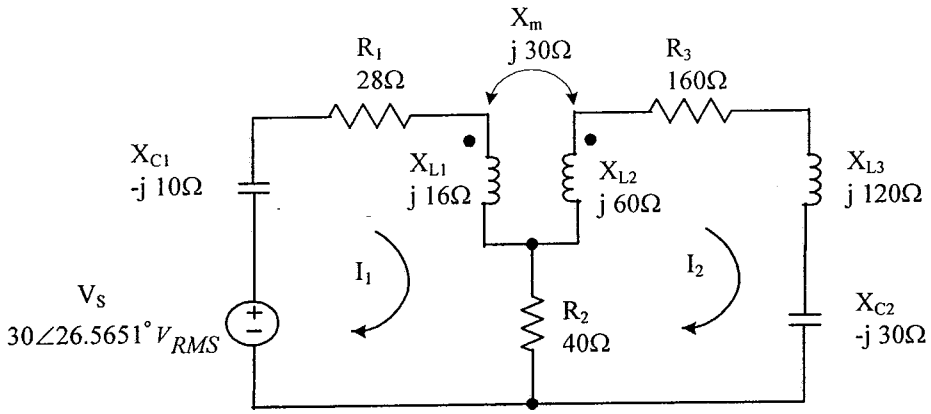
[Anda dibenarkan menjawab soalan sama ada dalam bahasa Malaysia atau bahasa Inggeris].

...2/-

1. (a) Dapatkan nilai pekali gandingan, I_1 dan I_2 bagi litar yang ditunjukkan dalam Rajah 1(a). Kirakan juga kuasa yang dilesapkan oleh perintang R_2.

Find the coupling coefficient, I_1 and I_2 in the circuit of Figure 1(a). Also, calculate the energy absorbed by resistor R_2.

(40%)

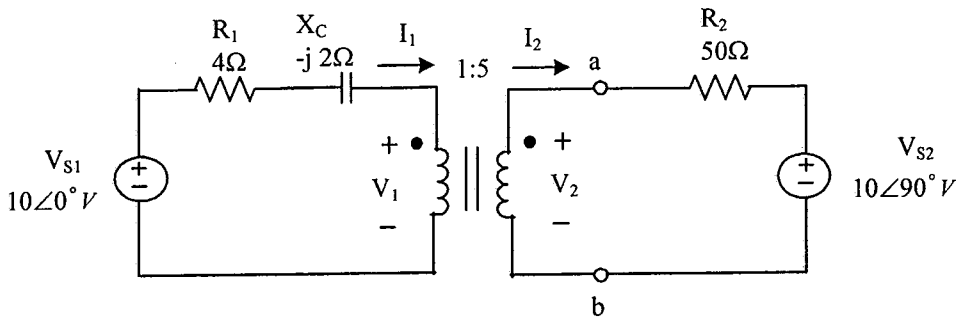


Rajah 1(a)
Figure 1(a)

(b) Dapatkan setara Thevenin bagi litar di sebelah kiri terminal a-b dalam Rajah 1(b). Kemudian, dapatkan nilai I_1, I_2, V_1 dan V_2.

Find the Thevenin equivalent of the circuit to the right side of the terminal a-b in Figure 1(b). Then, calculate I_1, I_2, V_1 and V_2.

(60%)



Rajah 1(b)
Figure 1(b)

...3/-

2. (a) Berpandukan Rajah 2(a), kirakan:

Based on Figure 2(a), calculate:

(i) Frekuensi saluran, ω_o.
Resonant frequency, ω_o.

(ii) Faktor kualiti, Q.
Quality factor, Q.

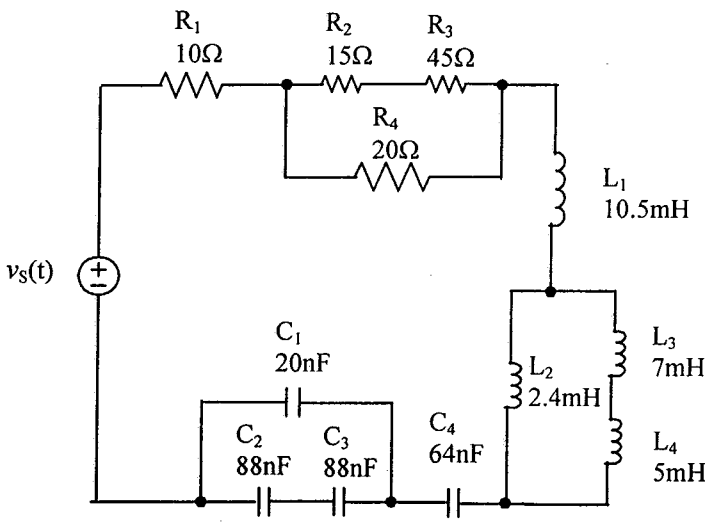
(iii) Lebar jalur, B.
Bandwidth, B.

(iv) Frekuensi-frekuensi kuasa-separuh (ω_1 dan ω_2).
Half-power frequencies (ω_1 and ω_2).

(v) Amplitud arus pada ω_0, ω_1 dan ω_2.
Amplitude of the current at ω_0, ω_1 and ω_2.

(vi) Nilai kuasa tertinggi yang dilesapkan oleh litar.
The highest power dissipated by the circuit.

(60%)



$v_S(t) = 10 \cos(\omega t + 10°)V$

Rajah 2(a)
Figure 2(a)

...4/-

(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:

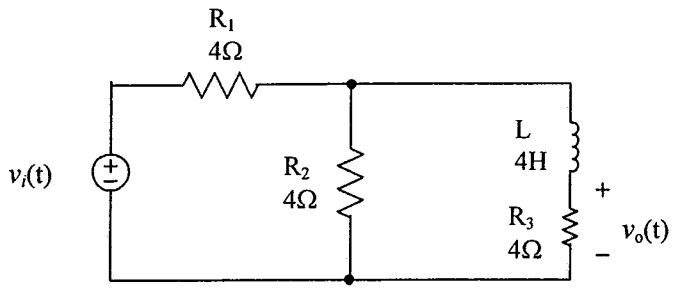
(i) Fungsi pindah H(s) = $v_o(s)/v_i(s)$
The transfer function H(s) = $v_o(s)/v_i(s)$

(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 $v_i(t)$ = 20 cos 10t V
$v_o(t)$ if $v_i(t)$ = 20 cos 10t V

(80%)

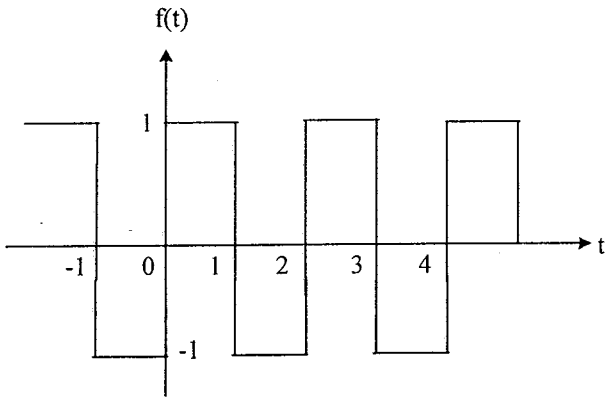


Rajah 3(b)
Figure 3(b)

...6/-

4. (a) Dapatkan siri Fourier untuk gelombang segi empat berkala yang ditunjukkan dalam Rajah 4(a). Plotkan spektrum amplitud dan fasa (sehingga harmonik ke-enam).

Find the Fourier series of the periodic square wave as shown in Figure 4(a). Plot the amplitude and phase spectra. (up to the sixth harmonic).

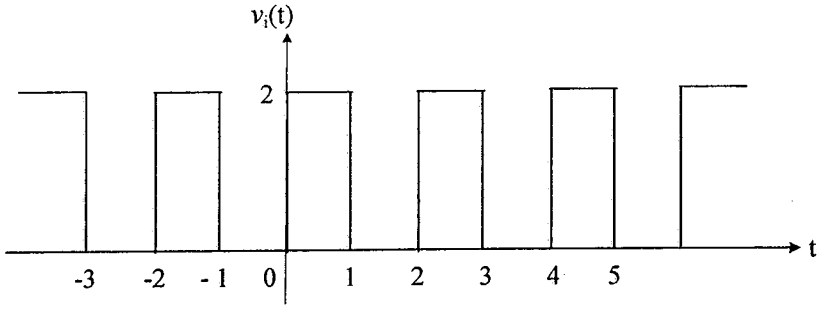


Rajah 4(a)
Figure 4(a)

(30%)

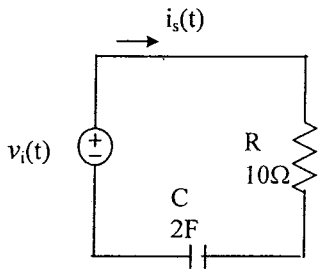
(b) Gelombang voltan berkala yang ditunjukkan dalam Rajah 4(b) merupakan voltan masukan yang dikenakan kepada litar dalam Rajah 4(c).

The periodic voltage waveform shown in Figure 4(b) is the input voltage applied to the circuit in Figure 4(c).



Rajah 4(b)
Figure 4(b)

...7/-



Rajah 4(c)
Figure 4(c)

(i) Dapatkan siri Fourier dalam bentuk trigonometri untuk mewakilkan voltan masukan, $v_i(t)$.

Find the trigonometric form of the Fourier series for the input voltage, $v_i(t)$. (10%)

(ii) Dapatkan siri Fourier dalam bentuk amplitud-fasa untuk mewakilkan voltan masukan, $v_i(t)$.

Find the amplitude-phase form of the Fourier series for the input voltage, $v_i(t)$.

(10%)

(iii) Dapatkan siri Fourier dalam bentuk amplitud-fasa untuk mewakilkan arus, $i_s(t)$. Tunjukkan kesemua langkah penyelesaian anda.

Find the amplitude-phase form of the Fourier series for the current, $i_s(t)$. *Show all your work.* (30%)

(iv) Anggarkan purata kuasa yang dibekalkan kepada litar menggunakan teori *Parseval* sehingga harmonik ke 4.

Approximate the average power supplied to the circuit using Parseval's theorem, up to 4^{th} *harmonic.*

(20%)

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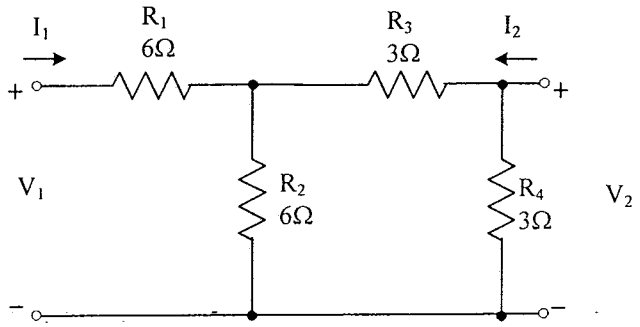
6. (a) Dapatkan parameter-parameter z bagi jaringan dua terminal yang ditunjukkan dalam Rajah 6(a).

Obtain the z parameters of the two port network in Figure 6(a).



Rajah 6(a)
Figure 6(a)

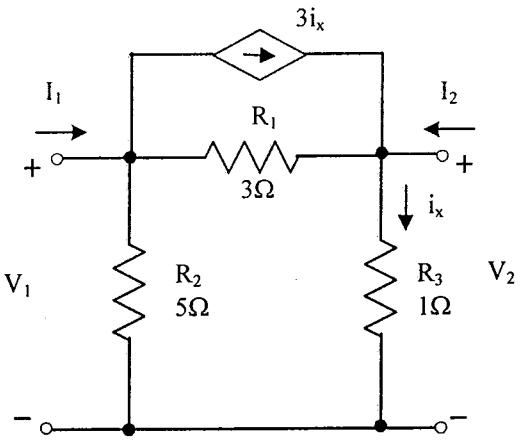
(30%)

(b) Dapatkan parameter T bagi jaringan dalam Rajah 6(a).
Obtain the T parameters for the network in Figure 6(a).

(20%)

(c) Dapatkan parameter-parameter y bagi jaringan dalam Rajah 6(b).
Obtain the y parameters for the network in Figure 6(b).

(50%)



Rajah 6(b)
Figure 6(b)

- 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	$\frac{df}{dt}$	$sF(s) - f(0^-)$
	$\frac{d^2 f}{dt^2}$	$s^2 F(s) - sf(0^-) - f'(0^-)$
	$\frac{d^3 f}{dt^3}$	$s^3 F(s) - s^2 f(0^-) - sf'(0^-) - f''(0^-)$
	$\frac{d^n f}{dt^n}$	$s^n F(s) - s^{n-1} f(0^-) - s^{n-2} f'(0^-) - \cdots - f^{(n-1)}(0^-)$
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}	$\frac{1}{h_{11}}$	$-\frac{h_{12}}{h_{11}}$	$\frac{\Delta_g}{g_{22}}$	$\frac{g_{12}}{g_{22}}$	$\frac{D}{B}$	$-\frac{\Delta_T}{B}$	$\frac{a}{b}$	$-\frac{1}{b}$
	$-\frac{z_{21}}{\Delta_z}$	$\frac{z_{11}}{\Delta_z}$	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

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

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

Fourier Transform Pairs

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