UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang Akademik 2003/2004

September/Oktober 2003

EEE 105 – TEORI LITAR I

Masa : 3 jam

ARAHAN KEPADA CALON:

Sila pastikan bahawa kertas peperiksaan ini mengandungi **DUABELAS (12)** muka surat termasuk 5 Lampiran bercetak dan **ENAM (6)** soalan sebelum anda memulakan peperiksaan ini.

Jawab **LIMA (5)** soalan.

Agihan markah bagi soalan diberikan disut sebelah kanan soalan berkenaan.

Jawab semua soalan di dalam Bahasa Malaysia.

...2/-

S1. (a) Bagi litar yang ditunjukkan dalam Rajah 1(a), gunakan kaedah jelmaan Δ-Y bagi menentukan

For the circuit shown in Figure 1(a), use Δ-Y equivalent circuit to determine.

(i) i_2

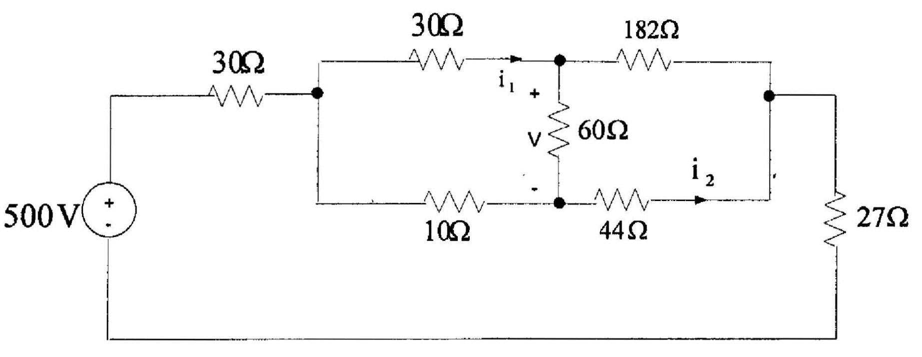
(ii) i_1

(iii) v

(iv) kuasa yang dibekalkan oleh punca voltan.

the power supplied by the voltage source.

(68 markah)



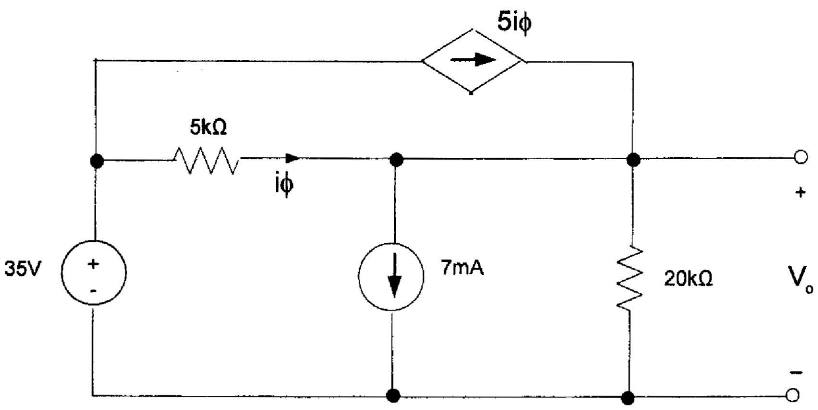
Rajah 1(a)
Figure 1(a)

(b) Gunakan prinsip superposisi untuk menentukan V_o bagi litar dalam Rajah 1(b)

Use the principle of superposition to find V_o in the circuit in Figure 1(b).

(32 markah)

...3/-

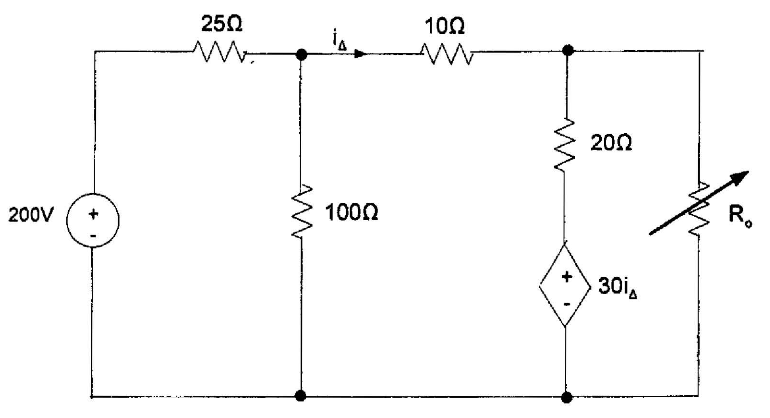


Rajah 1(b)
Figure 1(b)

S2. Perintang bolehubah (R_o) dalam litar Rajah 2 dilaraskan sehingga kuasa yang dilesapkan oleh perintang tersebut ialah 250W. Tentukan nilai-nilai R_o yang dapat memenuhi keadaan ini. Gunakan kaedah Thevenin untuk menyelesaikan masalah ini.

The variable resistor (R_o) in the circuit in Figure 2 is adjusted until the power dissipated in the resistor is 250W. Using Thevenin equivalent, find the values of R_o that satisfy this condition.

(100 markah)



Rajah 2
Figure 2

S3. Keempat-empat kapasitor dalam litar Rajah 3 adalah disambung merintangi teminal-terminal satu kotak hitam (seperti yang ditunjukkan dalam Rajah tersebut) pada t=0. Arus yang terhasil i_b pada $t \geq 0$ adalah

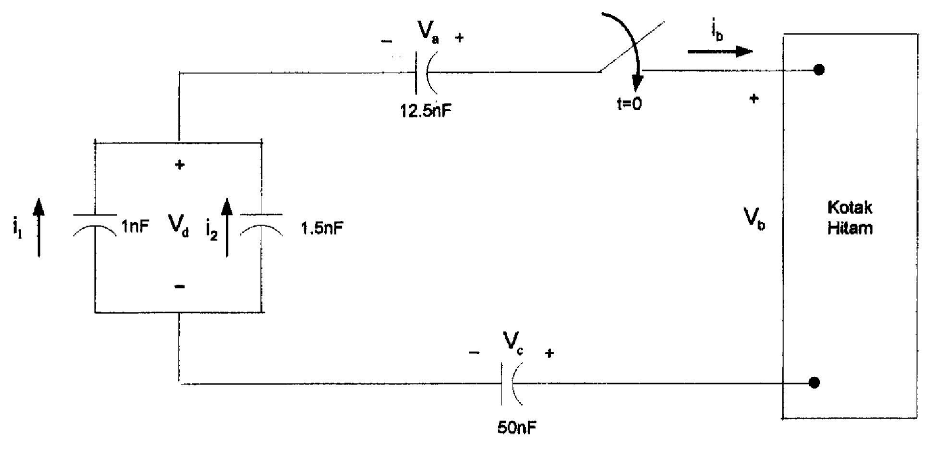
The four capacitors in the circuit in Figure 3 are connected across the terminals of a black box at t=0. The resulting current i_b for $t \geq 0$ is known to be

$$i_b = 50e^{-250t}\ \mu A$$

Jika $v_a(0) = 15V$, $v_c(0) = -45V$ dan $v_d(0) = 40V$, tentukan yang berikut pada $t \geq 0$:
If $v_a(0) = 15V$, $v_c(0) = -45V$ and $v_d(0) = 40V$, find the following for $t \geq 0$:

(a) $v_b(t)$
(b) $v_a(t)$
(c) $v_c(t)$
(d) $v_d(t)$
(e) $i_1(t)$
(f) $i_2(t)$

(100 markah)



Rajah 3
Figure 3

S4. Suis dalam litar Rajah 4 berada pada posisi a bagi jangka masa yang lama. Pada $t = 0$, suis bertukar serta merta dari a ke b.

The switch in circuit shown in Figure 4 has been in the position a for a long time. At $t = 0$, it moves instantaneously from a to b.

(a) Tentukan $v_o(t)$ bagi $t \geq 0^+$
Find $v_o(t)$ for $t \geq 0^+$

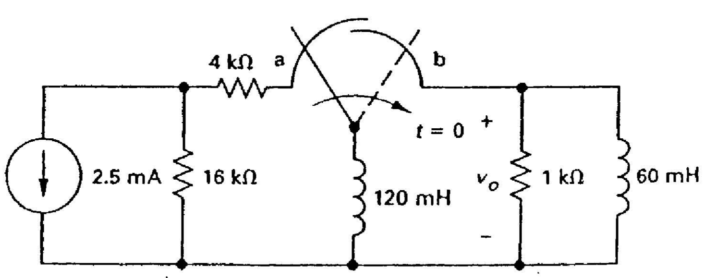
(30%)

(b) Tentukan jumlah tenaga yang dihantar kepada perintang 1 kΩ.
Find the total energy delivered to the 1 kΩ resistor.

(30%)

(c) Berapa angkatap masa digunakan untuk menghantar 95% tenaga yang ditentukan dalam bahagian (b)?
How many time constants does it take to deliver 95% of the energy found in (b)?

(40%)

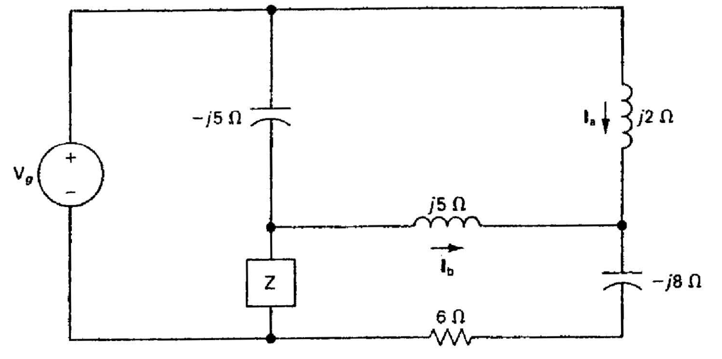


Rajah 4
Figure 4

S5. (a) Tentukan I_b dan Z pada litar Rajah 5(a) jika $V_g=60\angle 0°$ V dan $I_a=5\angle -90°$ A

Find I_b and Z in the circuit shown in Figure 5(a) if $V_g=60\angle 0°$ V dan $I_a=5\angle -90°$ A.

(60%)



Rajah 5(a)
Figure 5(a)

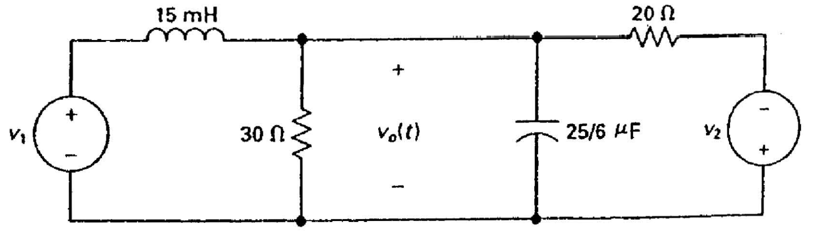
(b) Tentukan persamaan keadaan mantap pada litar Rajah 5(b) dengan menggunakan teknik penjelmaan punca. Punca voltan sinusoid adalah berikut:

Find the steady-state expression for in the circuit in Figure 5(b) by using the technique of source transformations. The sinusoidal voltage source are:

$$v_1=240\cos(4000t+53.13°)\text{V}$$
$$v_2=96\sin 4000t\text{V}.$$

(40%)

...7/-



Rajah 5(b)
Figure 5(b)

S6. Impedans beban Z_L untuk litar pada Rajah 6 diubah sehingga kuasa purata maximum dihantar kepada Z_L.

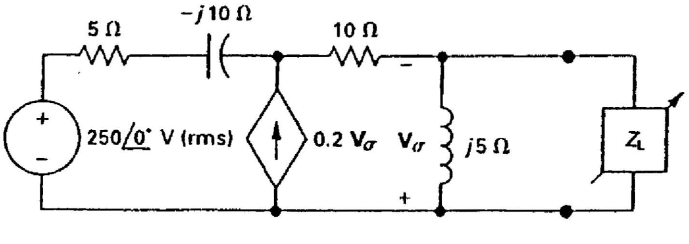
The load impedance Z_L for the circuit in figure 6 is adjusted until maximum average power is delivered to Z_L.

(a) Tentukan kuasa purata maximum yang dihantar kepada Z_L.
Find the maximum average power delivered to Z_L.

(60%)

(b) Berapa peratus daripada jumlah kuasa yang terdapat pada litar dihantar kepada Z_L.
What percentage of the total power developed in the circuit is delivered to Z_L.

(40%)



Rajah 6
Figure 6

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Appendix C

Mathematical Formulas

This appendix—by no means exhaustive—serves as a handy reference. It does contain all the formulas needed to solve circuit problems in this book.

C.1 Quadratic Formula

The roots of the quadratic equation $ax^2 + bx + c = 0$ are

$$x_1, x_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

C.2 Trigonometric Identities

$$\sin(-x) = -\sin x$$
$$\cos(-x) = \cos x$$
$$\sec x = \frac{1}{\cos x}, \qquad \csc x = \frac{1}{\sin x}$$
$$\tan x = \frac{\sin x}{\cos x}, \qquad \cot x = \frac{1}{\tan x}$$
$$\sin(x \pm 90°) = \pm\cos x$$
$$\cos(x \pm 90°) = \mp\sin x$$
$$\sin(x \pm 180°) = -\sin x$$
$$\cos(x \pm 180°) = -\cos x$$
$$\cos^2 x + \sin^2 x = 1$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \qquad \text{(law of sines)}$$
$$a^2 = b^2 + c^2 - 2bc\cos A \qquad \text{(law of cosines)}$$
$$\frac{\tan\frac{1}{2}(A-B)}{\tan\frac{1}{2}(A+B)} = \frac{a-b}{a+b} \qquad \text{(law of tangents)}$$

$$\sin(x \pm y) = \sin x\cos y \pm \cos x\sin y$$
$$\cos(x \pm y) = \cos x\cos y \mp \sin x\sin y$$
$$\tan(x \pm y) = \frac{\tan x \pm \tan y}{1 \mp \tan x\tan y}$$
$$2\sin x\sin y = \cos(x-y) - \cos(x+y)$$
$$2\sin x\cos y = \sin(x+y) + \sin(x-y)$$
$$2\cos x\cos y = \cos(x+y) + \cos(x-y)$$
$$\sin 2x = 2\sin x\cos x$$

$$\cos 2x = \cos^2 x - \sin^2 x = 2\cos^2 x - 1 = 1 - 2\sin^2 x$$

$$\tan 2x = \frac{2\tan x}{1 - \tan^2 x}$$

$$\sin^2 x = \frac{1}{2}(1 - \cos 2x)$$

$$\cos^2 x = \frac{1}{2}(1 + \cos 2x)$$

$$K_1 \cos x + K_2 \sin x = \sqrt{K_1^2 + K_2^2}\cos\left(x + \tan^{-1}\frac{-K_2}{K_1}\right)$$

$$e^{jx} = \cos x + j\sin x \qquad \text{(Euler's formula)}$$

$$\cos x = \frac{e^{jx} + e^{-jx}}{2}$$

$$\sin x = \frac{e^{jx} - e^{-jx}}{2j}$$

$$1 \text{ rad} = 57.296°$$

C.3 Hyperbolic Functions

$$\sinh x = \frac{1}{2}(e^x - e^{-x})$$

$$\cosh x = \frac{1}{2}(e^x + e^{-x})$$

$$\tanh x = \frac{\sinh x}{\cosh x}$$

$$\coth x = \frac{1}{\tanh x}$$

$$\operatorname{csch} x = \frac{1}{\sinh x}$$

$$\operatorname{sech} x = \frac{1}{\cosh x}$$

$$\sinh(x \pm y) = \sinh x \cosh y \pm \cosh x \sinh y$$

$$\cosh(x \pm y) = \cosh x \cosh y \pm \sinh x \sinh y$$

C.4 Derivatives

If $U = U(x)$, $V = V(x)$, and $a =$ constant,

$$\frac{d}{dx}(aU) = a\frac{dU}{dx}$$

$$\frac{d}{dx}(UV) = U\frac{dV}{dx} + V\frac{dU}{dx}$$

$$\frac{d}{dx}\left(\frac{U}{V}\right) = \frac{V\frac{dU}{dx} - U\frac{dV}{dx}}{V^2}$$

$$\frac{d}{dx}(aU^n) = naU^{n-1}$$

$$\frac{d}{dx}(a^U) = a^U \ln a\frac{dU}{dx}$$

$$\frac{d}{dx}(e^U) = e^U\frac{dU}{dx}$$

$$\frac{d}{dx}(\sin U) = \cos U\frac{dU}{dx}$$

$$\frac{d}{dx}(\cos U) = -\sin U\frac{dU}{dx}$$

C.5 Indefinite Integrals

If $U = U(x)$, $V = V(x)$, and $a =$ constant,

$$\int a\,dx = ax + C$$

$$\int U\,dV = UV - \int V\,dU \qquad \text{(integration by parts)}$$

$$\int U^n\,dU = \frac{U^{n+1}}{n+1} + C, \qquad n \neq 1$$

$$\int \frac{dU}{U} = \ln U + C$$

$$\int a^U\,dU = \frac{a^U}{\ln a} + C, \qquad a > 0, a \neq 1$$

$$\int e^{ax}\,dx = \frac{1}{a}e^{ax} + C$$

$$\int xe^{ax}\,dx = \frac{e^{ax}}{a^2}(ax - 1) + C$$

$$\int x^2e^{ax}\,dx = \frac{e^{ax}}{a^3}(a^2x^2 - 2ax + 2) + C$$

C.6 Definite Integrals

If m and n are integers,

$$\int_0^{2\pi} \sin ax\, dx = 0$$

$$\int_0^{2\pi} \cos ax\, dx = 0$$

$$\int_0^{\pi} \sin^2 ax\, dx = \int_0^{\pi} \cos^2 ax\, dx = \frac{\pi}{2}$$

$$\int_0^{\pi} \sin mx \sin nx\, dx = \int_0^{\pi} \cos mx \cos nx\, dx = 0, \quad m \neq n$$

$$\int_0^{\pi} \sin mx \cos nx\, dx = \begin{cases} 0, & m+n = \text{even} \\ \dfrac{2m}{m^2 - n^2}, & m+n = \text{odd} \end{cases}$$

$$\int_0^{2\pi} \sin mx \sin nx\, dx = \int_{-\pi}^{\pi} \sin mx \sin nx\, dx = \begin{cases} 0, & m \neq n \\ \pi, & m = n \end{cases}$$

$$\int_0^{\infty} \frac{\sin ax}{x}\, dx = \begin{cases} \dfrac{\pi}{2}, & a > 0 \\ 0, & a = 0 \\ -\dfrac{\pi}{2}, & a < 0 \end{cases}$$

C.7 L'Hopital's Rule

If $f(0) = 0 = h(0)$, then

$$\lim_{x \to 0} \frac{f(x)}{h(x)} = \lim_{x \to 0} \frac{f'(x)}{h'(x)}$$

where the prime indicates differentiation.

APPENDIX C Mathematical Formulas

$$\int \ln x\, dx = x \ln x - x + C$$

$$\int \sin ax\, dx = -\frac{1}{a}\cos ax + C$$

$$\int \cos ax\, dx = \frac{1}{a}\sin ax + C$$

$$\int \sin^2 ax\, dx = \frac{x}{2} - \frac{\sin 2ax}{4a} + C$$

$$\int \cos^2 ax\, dx = \frac{x}{2} + \frac{\sin 2ax}{4a} + C$$

$$\int x \sin ax\, dx = \frac{1}{a^2}(\sin ax - ax\cos ax) + C$$

$$\int x \cos ax\, dx = \frac{1}{a^2}(\cos ax + ax\sin ax) + C$$

$$\int x^2 \sin ax\, dx = \frac{1}{a^3}(2ax \sin ax + 2\cos ax - a^2x^2\cos ax) + C$$

$$\int x^2 \cos ax\, dx = \frac{1}{a^3}(2ax \cos ax - 2\sin ax + a^2x^2\sin ax) + C$$

$$\int e^{ax} \sin bx\, dx = \frac{e^{ax}}{a^2+b^2}(a\sin bx - b\cos bx) + C$$

$$\int e^{ax} \cos bx\, dx = \frac{e^{ax}}{a^2+b^2}(a\cos bx + b\sin bx) + C$$

$$\int \sin ax \sin bx\, dx = \frac{\sin(a-b)x}{2(a-b)} - \frac{\sin(a+b)x}{2(a+b)} + C, \qquad a^2 \neq b^2$$

$$\int \sin ax \cos bx\, dx = -\frac{\cos(a-b)x}{2(a-b)} - \frac{\cos(a+b)x}{2(a+b)} + C, \qquad a^2 \neq b^2$$

$$\int \cos ax \cos bx\, dx = \frac{\sin(a-b)x}{2(a-b)} + \frac{\sin(a+b)x}{2(a+b)} + C, \qquad a^2 \neq b^2$$

$$\int \frac{dx}{a^2+x^2} = \frac{1}{a}\tan^{-1}\frac{x}{a} + C$$

$$\int \frac{x^2\, dx}{a^2+x^2} = x - a\tan^{-1}\frac{x}{a} + C$$

$$\int \frac{dx}{(a^2+x^2)^2} = \frac{1}{2a^2}\left(\frac{x}{x^2+a^2} + \frac{1}{a}\tan^{-1}\frac{x}{a}\right) + C$$