KOLEJ YAYASAN PELAJARAN JOHOR

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FINAL EXAMINATION

COURSE NAME	:	**CIRCUIT ANALYSIS**
COURSE CODE	:	**DEE 2113**
EXAMINATION	:	**JUNE 2024**
DURATION	:	**2 HOURS AND 30 MINUTES**

INSTRUCTION TO CANDIDATES /
ARAHAN KEPADA CALON

1. This examination paper consists of **ONE (1)** part : / PART A (100 Marks) /
   *Kertas soalan ini mengandungi **SATU (1)** bahagian:* *BAHAGIAN A (100 Markah)*

2. Candidates are not allowed to bring any material to examination room except with the permission from the invigilator. The formula was attached at the back question paper. /
   Calon tidak dibenarkan untuk membawa sebarang bahan/nota ke bilik peperiksaan tanpa arahan/kebenaran daripada pengawas. Rumus dilampirkan di belakang kertas soalan peperiksaan.

3. Please check to make sure that this examination pack consists of: /
   Pastikan kertas soalan peperiksaan ini mengandungi:
   i. Question Paper /
      Kertas Soalan
   ii. Answering Booklet /
      Buku Jawapan

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO /
JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

This examination paper consists of **9** printed pages including front page
*Kertas soalan ini mengandungi **9** muka surat termasuk kulit hadapan*

This part contains of **FOUR(4)** questions. Answer **ALL** questions in the Answering Booklet.

*Bahagian ini mempunyai **EMPAT(4)** soalan. Jawab **SEMUA** soalan di dalam Buku Jawapan.*

QUESTION 1 / *SOALAN 1*

a) Find the equivalent inductance, Leq between terminal a and b of the circuit in **Figure 1a**.

*Cari kearuhan setara, Leq antara terminal a dan b dalam litar **Rajah 1a**.*

(7 marks / *markah*)

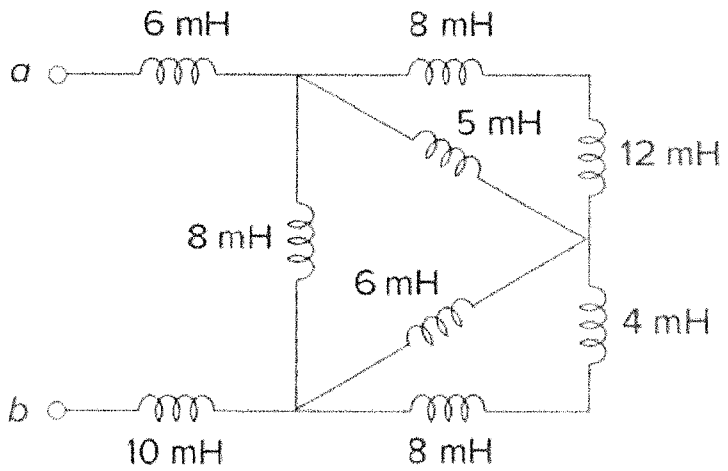

Figure 1a/ *Rajah 1a*

b) The switch in the circuit in **Figure 1b** has been closed for a long time, and it is opened at t= 0. Find v(t) for t $\geq$ 0. Calculate the initial energy stored in the capacitor.

*Suis dalam litar dalam **Rajah 1b** telah ditutup untuk masa yang lama, dan suis dibuka pada t= 0. Cari v(t) untuk t $\geq$ 0. Hitung tenaga awal yang disimpan dalam pemuat.*

(18 marks / *markah*)

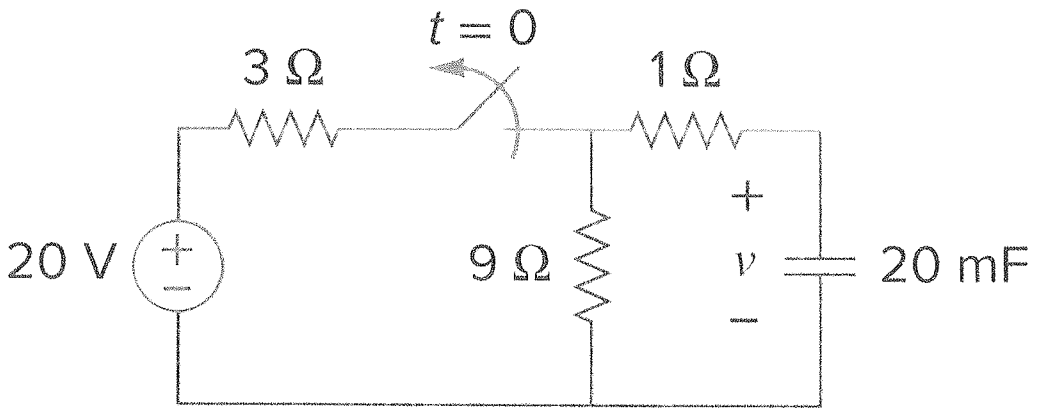

Figure 1b/ *Rajah 1b*

QUESTION 2 / *SOALAN 2*

a) The switch in **Figure 2a** has been in position A for a long time. At t = 0, the switch moves to position B. Determine v(t) for t > 0 and calculate its value at t = 4.

*Suis dalam **Rajah 2a** telah berada pada kedudukan A untuk masa yang lama. Pada t = 0, suis bergerak ke kedudukan B. Tentukan v(t) untuk t > 0 dan hitung nilai pada t = 4.*

(13 marks / *markah*)

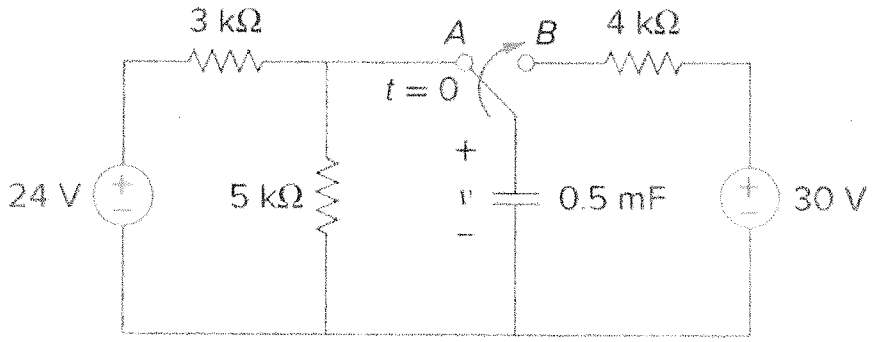

Figure 2a/ *Rajah 2a*

b) In **Figure 2b**, calculate the characteristic roots of the circuit α, ω_o , s_1 and s_2. Determine the type of natural response overdamped, underdamped or critically damped.

*Dalam **Rajah 2b**, hitung punca ciri litar α, ω_o , s_1 dan s_2. Tentukan jenis tindak balas semula jadi terlampau peredam, kurang peredam atau kritikal peredam.*

(12 marks / *markah*)

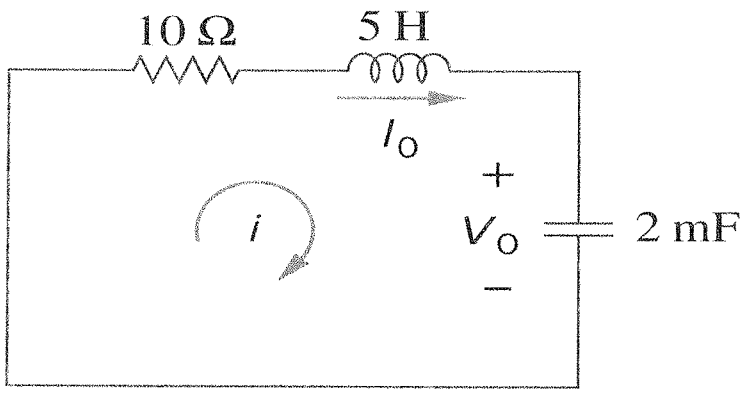

Figure 2b/ *Rajah 2b*

QUESTION 3 / *SOALAN 3*

a) For the circuit in **Figure 3a**, find v(t) for t > 0.

*Untuk litar dalam **Rajah 3a**, cari v(t) untuk t > 0.*

(19 marks / *markah*)

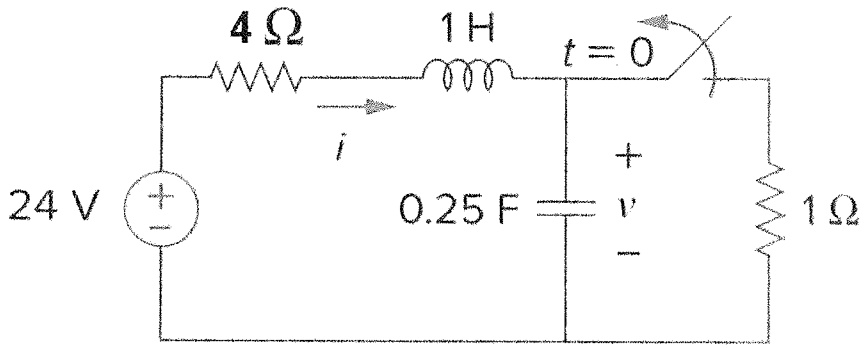

Figure 3a/ *Rajah 3a*

b) Determine the inverse laplace transform of these functions:

Tentukan penjelmaan laplace songsang bagi fungsi-fungsi ini:

i) $$F(s) = \frac{1}{s-2}$$

(2 marks / *markah*)

ii) $$F(s) = \frac{2}{s^5}$$

(2 marks / *markah*)

iii) $$F(s) = \frac{1}{2s-1}$$

(2 marks / *markah*)

QUESTION 4 / *SOALAN 4*

a) Determine I_1 and I_2 in the circuit of **Figure 4a**.

*Tentukan I_1 dan I_2 dalam litar pada **Rajah 4a**.*

(13 marks / *markah*)

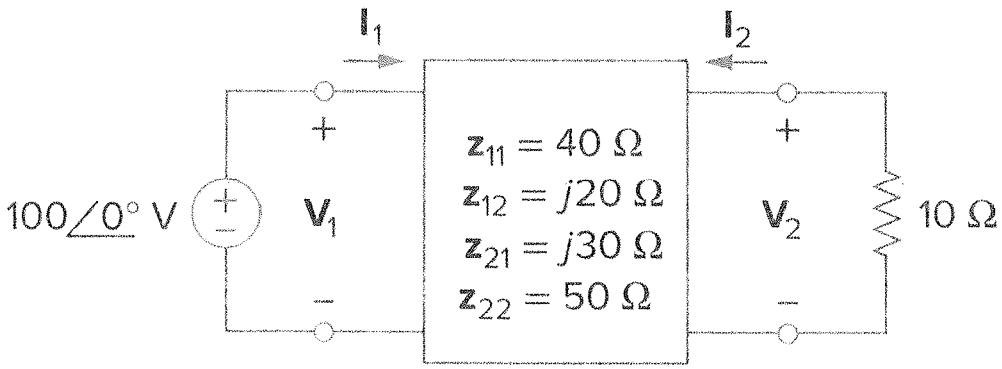

Figure 4a / *Rajah 4a*

b) Find [z] and [g] parameters of a two-port network if

Cari parameter [z] dan [g] bagi rangkaian dua-liang jika

$$|T| = \begin{bmatrix} 10 & 1.5 \\ 2S & 4 \end{bmatrix}$$

(12 marks / *markah*)

[100 MARKS / *MARKAH*]

END OF QUESTION PAPER/ *KERTAS SOALAN TAMAT*

APPENDIX/ *LAMPIRAN*

List of Formula

$q = Cv$; $i = C\frac{dv}{dt}$; $w = \frac{1}{2}Cv^2$

$v = L\frac{di}{dt}$; $w = \frac{1}{2}Li^2$

$v(t) = V_0\, e^{-t/\tau}$ where $\tau = RC$

$i(t) = I_0\, e^{-t/\tau}$ **where** $\tau = \frac{L}{R}$

v(0-) = v(0+) = V_0

$V_s + (V_0 - V_s)e^{-t/\tau}$

$v(t) = v(\infty) + [v(0+) - v(\infty)]e^{-t/\tau}$

$i(t) = i(\infty) + [i(0+) - i(\infty)]e^{-t/\tau}$

If $\alpha > \omega_o$, over-damped case

$i(t) = A_1 e^{s_1 t} + A_2 e^{s_2 t}$ **where** $s_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2}$

If $\alpha = \omega_o$, critical damped case

$i(t) = (A_2 + A_1 t)e^{-\alpha t}$ **where** $s_{1,2} = -\alpha$

If $\alpha < \omega_o$, under-damped case

$i(t) = e^{-\alpha t}(B_1 \cos\omega_d t + B_2 \sin\omega_d t)$ **where** $\omega_d = \sqrt{\omega_0^2 - \alpha^2}$

$\alpha = \frac{R}{2L}$; $\omega_0 = \frac{1}{\sqrt{LC}}$

$\alpha = \frac{1}{2RC}$, $\omega_0 = \frac{1}{\sqrt{LC}}$

Table 1: Laplace Transform;

S.no	$f(t)$	$\mathcal{L}\{f(t)\}$	S.no	$f(t)$	$\mathcal{L}\{f(t)\}$
1	1	$\frac{1}{s}$	11	$e^{at}\sinh bt$	$\frac{b}{(s-a)^2-b^2}$
2	e^{at}	$\frac{1}{s-a}$	12	$e^{at}\cosh bt$	$\frac{s-a}{(s-a)^2-b^2}$
3	t^n	$\frac{n!}{s^{n+1}}$	13	$t\cos at$	$\frac{s^2-a^2}{(s^2+a^2)^2}$
4	$\sin at$	$\frac{a}{s^2+a^2}$	14	$t\sin at$	$\frac{2as}{(s^2+a^2)^2}$
5	$\cos at$	$\frac{s}{s^2+a^2}$	15	$f'(t)$	$sF(s)-f(0)$
6	$\sinh at$	$\frac{a}{s^2-a^2}$	16	$f''(t)$	$s^2F(s)-sf(0)-f'(0)$
7	$\cosh at$	$\frac{s}{s^2-a^2}$	17	$\int_0^t f(u)du$	$\frac{1}{s}F(s)$
8	$e^{at}t^n$	$\frac{n!}{(s-a)^{n+1}}$	18	$t^nf(t)$ Where $n=1,2,3,..$	$(-1)^n\frac{d^n}{ds^n}\{F(s)\}$
9	$e^{at}\cos bt$	$\frac{s-a}{(s-a)^2+b^2}$	19	$\frac{1}{t}\{f(t)\}$	$\int_s^\infty F(s)ds$
10	$e^{at}\sin bt$	$\frac{b}{(s-a)^2+b^2}$	20	$e^{at}f(t)$	$F(s-a)$

Table 2: Conversion of two-port parameters

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

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

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