POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENGAJIAN POLITEKNIK
KEMENTERIAN PENDIDIKAN MALAYSIA

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI DISEMBER 2013

EE602: CIRCUIT ANALYSIS

TARIKH : 07 APRIL 2014
TEMPOH : 8.30 AM – 10.30 AM (2 JAM)

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.
Bahagian A: Struktur (10 soalan)
Bahagian B: Esei (3 soalan)
Dokumen sokongan yang disertakan : *Laplace Transform Table*

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SECTION A : 40 MARKS
BAHAGIAN A : 40 MARKAH

INSTRUCTION:
This section consists of **TEN (10)** structured questions. Answer **ALL** questions.

ARAHAN :
*Bahagian ini mengandungi **SEPULUH (10)** soalan berstruktur. Jawab **semua soalan**.*

QUESTION 1

CLO1
C3

Solve Mesh 1 and Mesh 2 equations for the circuit in Figure A1.

SOALAN 1

Selesaikan persamaan Jaringan 1 dan Jaringan 2 bagi litar pada Rajah A1.

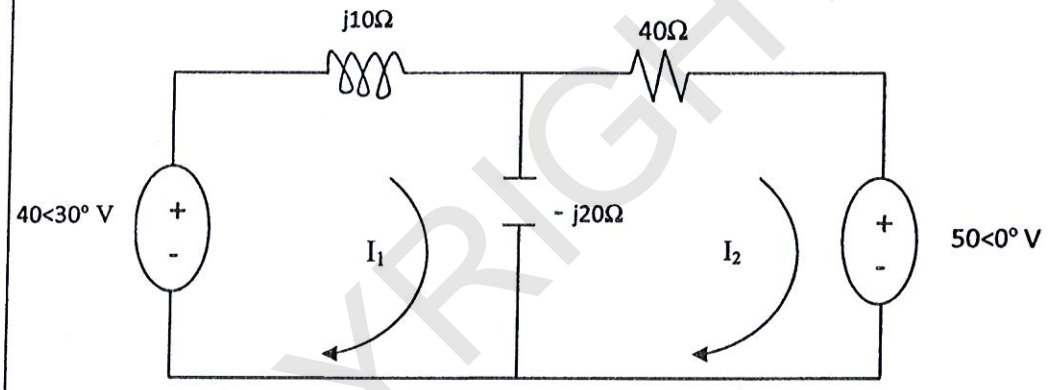

Figure A1 / *Rajah A1*

(4 marks)
(4 markah)

QUESTION 2

CLO1
C3

Referring to Figure A2 below, calculate the value of voltage,V.

SOALAN 2

Merujuk kepada Rajah A2 di bawah, kirakan nilai bagi voltan,V.

[4 Marks]

[*4 Markah*]

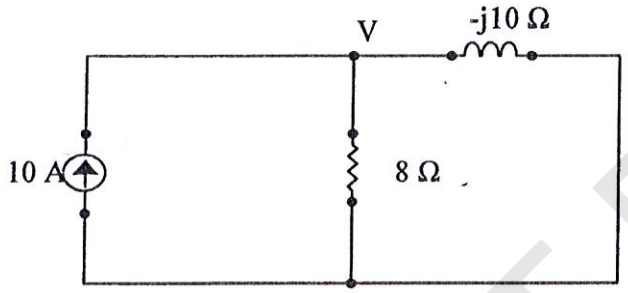

Figure A2 / *Rajah A2*

QUESTION 3

CLO1
C3

Calculate the value of Norton Currrent, I_N in diagram A4 at terminal *a-b*

SOALAN 3

Kirakan nilai arus Norton, I_N di dalam Rajah A4 pada terminal a-b .

[4 marks]
[*4 markah*]

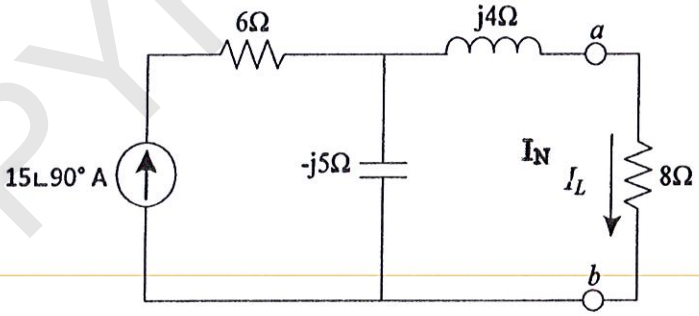

Figure A3 / *Rajah A3*

QUESTION 4

CLO1 C2

Reffering to Figure A4, transform the circuit from Δ to Y configuration.

SOALAN 4

Berdasarkan Rajah A4, tukarkan litar daripada konfigurasi Δ kepada konfigurasi Y.

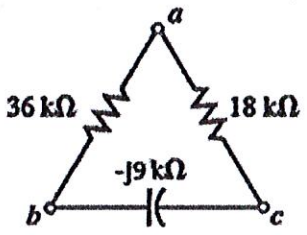

Figure A4 / Rajah A4 [4 marks]

[4 *markah*]

QUESTION 5

CLO1 C3

Solve the Laplace Transformation of the following functions f(t) by using Laplace Transformation Table.

SOALAN 5

Dapatkan Jelmaan Laplace bagi fungsi f(t) berikut dengan menggunakan Jadual Jelmaan Laplace.

$$f(t) = 3e^{-2t} + 4\cos 4t - 9\sin 3t$$

[4 marks]
[*4 markah*]

QUESTION 6

CLO1 C3

Calculate the Inverse Laplace Transformation of the following function F(s) by using Partial Fraction.

SOALAN 6

Kirakan Jelmaan Laplace Songsang bagi fungsi F(s) berikut dengan menggunakan Pecahan Separa.

$$F(s) = \frac{s+10}{s^2-4s-12}$$

[4 marks]

[*4 markah*]

QUESTION 10

CLO2
C3

Produce the analytical expression for the periodic waveform shown in Figure A10.

SOALAN 10

Dapatkan ungkapan analitik bagi gelombang berkala seperti ditunjukkan di Rajah A10.

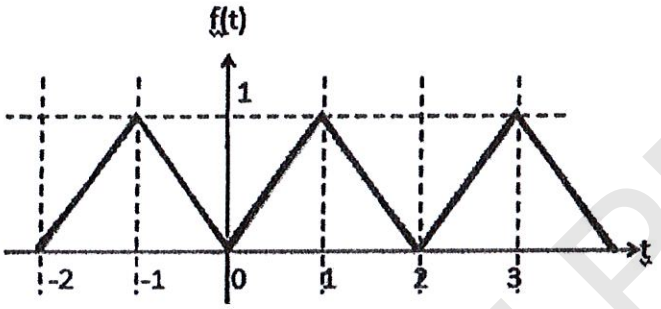

Figure A10 / *Rajah A10*

[4 marks]
[*4 markah*]

SECTION B : 60 MARKS
BAHAGIAN B : 60 MARKAH

INSTRUCTION:
This section consists of **THREE (3)** essay questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **TIGA (3)** soalan esei. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO2
C3

(a) Calculate the value of I_x in the circuit in Figure B(1a) using Thevenin Analysis.

Kirakan nilai I_x bagi litar dalam Rajah B(1a) menggunakan Analisa Thevenin.

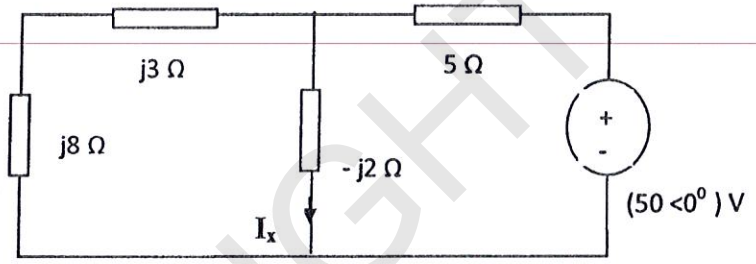

Figure B(1a) / *Rajah B(1a)*

[10 marks]
[*10 markah*]

CLO2
C3

(b) Calculate the value of Ix in the circuit in Figure B(1b) using Mesh Analysis.

Kirakan nilai I_x bagi litar dalam Rajah B(1b) menggunakan Analisa Mesh.

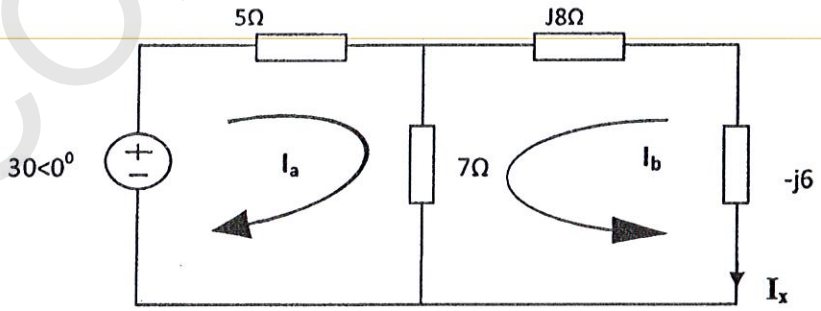

Figure B(1b) / *Rajah B(1b)*

[10 marks]
[*10 markah*]

CLO3
C3

QUESTION 2
SOALAN 2

(a) Solve $\frac{dx}{dt} - 4x = 8$, given $x = 2$ [or *f(0)=2*] when t=0

Selesaikan $\frac{dx}{dt} - 4x = 8$, *diberi* $x = 2$ *pada masa t=0*

[9 marks]
[*9 markah*]

(b) Based on Figure B(2b), calculate the value of i(t) by using Laplace transformation when S1 switch is closed. Given t = 0, q_o = 2.5mC

Berdasarkan Rajah B(2b), kira nilai i(t) dengan menggunakan Jelmaan Laplace apabila suiz S1 ditutup. Diberi pada masa t=0, q_o = 2.5mC

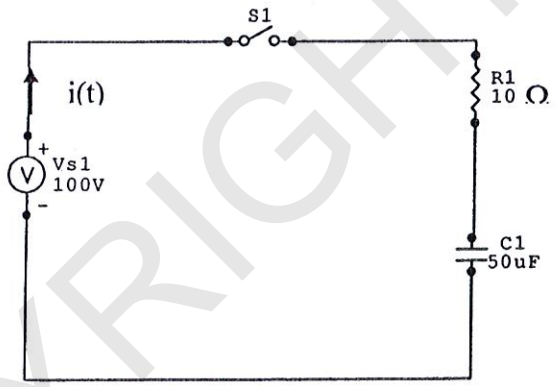

Figure B(2b)

[11 marks]
[*11 markah*]

QUESTION 3
SOALAN 3

CLO3
C3

a) Produce the trigonometric Fourier series expression.
Dapatkan persamaan Siri Fourier Trigonometri.

[10 marks]
[*10 markah*]

b) Referring to Diagram B(3b), calculate A_0.
Merujuk kepada Rajah B(3b), kirakan nilai A_0.

[10 marks]
[*10 markah*]

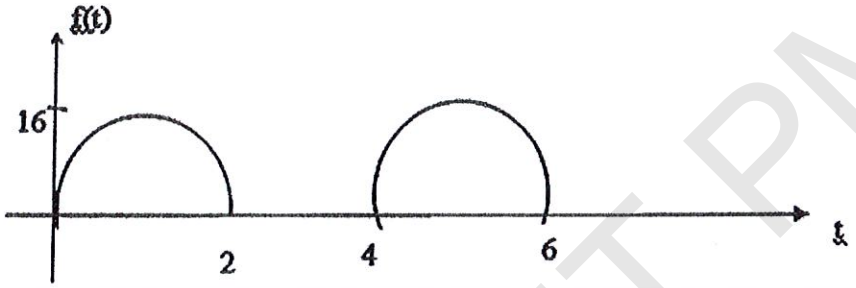

Figure B(3b) / *Rajah B(3b)*

SOALAN TAMAT

connection	Phase voltages/currents	Line voltages/currents
Y - Δ	$V_{an} = V_p \angle 0°$ $V_{bn} = V_p \angle -120°$ $V_{cn} = V_p \angle +120°$ $I_{AB} = V_{AB} / Z_\Delta$ $I_{BC} = V_{BC} / Z_\Delta$ $I_{CA} = V_{CA} / Z_\Delta$	$V_{ab} = V_{AB} = \sqrt{3V_p} \angle 30°$ $V_{bc} = V_{BC} = V_{ab} \angle -120°$ $V_{ca} = V_{CA} = V_{ab} \angle +120°$ $I_a = I_{AB} \sqrt{3} \angle -30°$ $I_b = I_a \angle -120°$ $I_c = I_a \angle +120°$
Δ - Y	$V_{ab} = V_p \angle 0°$ $V_{bc} = V_p \angle -120°$ $V_{ca} = V_p \angle +120°$	Same as phase voltages
	same as line currents	$I_a = \frac{V_n \angle -30°}{\sqrt{3Z_Y}}$ $I_b = I_a \angle -120°$ $I_c = I_a \angle +120°$

First derivative :	Overview of Fourier analysis :
$\mathcal{L}[f'(t)] = s\,\mathcal{L}[f(t)] - f(0)$	$f(t) = a_0 + \sum_{n=1}^{\infty} (a_n \cos(2\pi n f_0 t) + b_n \sin(2\pi n f_0 t)$
Second derivative :	Alternative form of the Fourier series :
$\mathcal{L}[f''(t)] = s^2\,\mathcal{L}[f(t)] - s f(0) - f'(0)$	$A_n = \sqrt{a_n^2 + b_n^2}$ and $\phi_n = \tan^{-1}\frac{-b_n}{a_n}$

	$\mathcal{L}^{-1}\{F(s)\} = f(t)$	$F(s) = \mathcal{L}\{f(t)\}$
i.	1	$\frac{1}{s}$
ii.	k	$\frac{k}{s}$
iii.	e^{at}	$\frac{1}{s-a}$
iv.	$\sin at$	$\frac{a}{s^2+a^2}$
v.	$\cos at$	$\frac{s}{s^2+a^2}$
vi.	t	$\frac{1}{s^2}$
vii.	t^2	$\frac{2!}{s^3}$
viii.	t^n	$\frac{n!}{s^{n+1}}$
ix.	$\sinh at$	$\frac{a}{s^2-a^2}$
x.	$\cosh at$	$\frac{s}{s^2-a^2}$
xi.	$e^{at}t^n$	$\frac{n!}{(s-a)^{n+1}}$
xii.	$e^{at}\sin \omega t$	$\frac{\omega}{(s-a)^2+\omega^2}$
xiii.	$e^{at}\cos \omega t$	$\frac{s-a}{(s-a)^2+\omega^2}$
xiv.	$e^{at}\sinh \omega t$	$\frac{\omega}{(s-a)^2-\omega^2}$
xv.	$e^{at}\cosh \omega t$	$\frac{s-a}{(s-a)^2-\omega^2}$

Waveform	Fourier coefficients	waveform	Fourier coefficients
Constant (dc)	$\alpha_0 = A$ $\alpha_n = 0$ all n $b_n = 0$ all n	Sawtooth wave	$\alpha_0 = \frac{A}{2}$ $\alpha_0 = 0$ all n $b_n = -\frac{A}{n\pi}$ all n
Cosine wave	$\alpha_0 = 0$ $\alpha_1 = A$ $\alpha_n = 0$ n $\neq 1$ $b_n = 0$ all n	Triangular wave	$\alpha_0 = 0$ $\alpha_n = \frac{8A}{(n\pi)^2}$ $n\ odd$ $\alpha_n = 0$ $n\ even$ $b_n = 0$ $all\ n$
Sine wave	$\alpha_0 = 0$ $\alpha_n = 0\ all\ n$ $b_1 = A$ $b_n = 0$ n $\neq 1$	Half – wave rectified sine wave	$\alpha_0 = \frac{A}{\pi}$ $\alpha_n = \frac{2A/\pi}{1-n^2}$ $n\ even$ $\alpha_n = 0$ $n\ odd$ $b_1 = \frac{A}{2}$ $n = 1$ $b_n = 0$ $n \neq 1$
Square wave	$\alpha_0 = 0$ $\alpha_n = 0\ all\ n$ $b_n = \frac{4A}{n\pi}$ $n\ odd$ $b_n = 0$ n even	Full – wave rectified sine wave	$\alpha_0 = \frac{2A}{\pi}$ $\alpha_n = \frac{4A/\pi}{1-n^2}$ $n\ even$ $\alpha_n = 0$ $n\ odd$ $b_n = 0$ $all\ n$
Rectangular pulse	$\alpha_0 = \frac{AT}{T_0}$ $\alpha_n = \frac{2A}{n\pi}\sin\left(\frac{n\pi T}{T_0}\right)$ $b_n = 0$ all n	Parabolic wave	$\alpha_0 = 0$ $\alpha_n = 0\ all\ n$ $b_n = \frac{32A}{(n\pi)^3}$ $n\ odd$ $b_n = 0$ $n\ even$