KOLEJ UNIVERSITI TEKNOLOGI TUN HUSSEIN ONN

PEPERIKSAAN AKHIR
SEMESTER I
SESI 2006/2007

NAMA MATAPELAJARAN	: ANALISIS & SINTESIS RANGKAIAN ELEKTRIK
KOD MATAPELAJARAN	: BEE 3113
KURSUS	: 3BER/3BET/2BEM/2BEP/2BER/2BET
TARIKH PEPERIKSAAN	: NOVEMBER 2006
JANGKA MASA	: 3 JAM
ARAHAN	: JAWAB **LIMA (5)** SOALAN SAHAJA DARIPADA TUJUH (7) SOALAN.

KERTAS SOALAN INI MENGANDUNGI 18 MUKA SURAT.

SOALAN DALAM BAHASA MELAYU

S1 Dengan menggunakan Jadual S1 sebagai rujukan.

(a) Tentukan Jelmaan Laplace bagi persamaan-persamaan berikut:

(i) $f(t) = e^{-3t}\sin(9t-5)$

(ii) $f(t) = 3t^2u(t) + e^{-5(t-3)}u(t-3)$

(iii) $f(t) = sinh\,5(t-2)$

(iv) $f(t) = sin\,4t[u(t) - u(t-\pi)]$

(8 markah)

(b) Dapatkan jelmaan Laplace bagi isyarat dalam Rajah S1(b(i)) dan Rajah S1(b(ii)).
(7 markah)

(c) Tentukan jelmaan Laplace songsang bagi persamaan-persamaan berikut:

(i) $F(s) = \dfrac{1}{s} + \dfrac{2}{s+1}$

(2 markah)

(ii) $F(s) = \dfrac{3s+1}{(s+4)}$

(3 markah)

S2 (a) Berdasarkan litar dalam Rajah S2(a),

(i) lukiskan gambarajah litar bagi $t < 0$ dan $t > 0$.

(1 markah)

(ii) kirakan faktor redaman, α dan frekuensi salun, ω_0.

(2 markah)

(iii) tentukan punca-punca persamaan ciri, s_1 dan s_2.

(2 markah)

(iv) cari nilai $i(0)$, $v(0)$ dan $\frac{dv(0)}{dt}$.

(4 markah)

(v) berdasarkan jawapan yang diperolehi pada S2(ii), tentukan jenis sambutan bagi litar.

(1 markah)

(b) Berikan definisi bagi istilah pelingkaran.

(2 markah)

(c) Berdasarkan Rajah S2(c),

(i) lukiskan gambarajah lipatan pada paksi y bagi isyarat $x_1(t)$.

(1 markah)

(ii) tentukan pelingkaran di antara isyarat $x_1(t)$ dan $x_2(t)$ bagi $0 < t < 4$. Secara grafik, tunjukkan gambarajah pelingkaran di antara kedua-dua isyarat ini.

(7 markah)

S3 (a) Rajah S3(a) menunjukkan litar penapis lulus rendah tertib kedua. Diberi nilai perintang, R adalah 2.828 kΩ dan rangkap pindah untuk litar tersebut adalah

$$H(s) = \frac{I_{out}(s)}{I_{in}(s)} = \frac{1}{4\times10^{-8}s^2 + 2.828\times10^{-4}s + 1}.$$

Berdasarkan rangkap pindah tersebut,

(i) tentukan nilai ζ dan ω_n.

(4 markah)

(ii) lakarkan plot Bode untuk perwakilan magnitud gandaan rangkap pindah dan tunjukkan kesan ζ terhadap lakaran graf magnitud tersebut.

(4 markah)

(iii) dapatkan nilai L dan C untuk litar tersebut.

(4 markah)

(b) Rajah S3(b) menunjukkan graf arus melawan frekuensi bagi litar RLC sesiri. Diberi nilai $\omega_0 = 50000$ rad/s, $\omega_1 = 49000$ rad/s dan $\omega_2 = 51000$ rad/s.

Berdasarkan graf tersebut,

(i) dapatkan lebar jalur, B dan kualiti faktor, Q

(4 markah)

(ii) rekabentuk litar RLC sesiri tersebut dan tentukan nilai R dan C. Gunakan nilai L=1mH dalam rekabentuk litar anda.

(4 markah)

S4 Rajah S4 menunjukkan sebuah litar penapis pasif.

(a) Dapatkan rangkap pindah litar tersebut.

(5 markah)

(b) Buktikan bahawa litar adalah penapis lulus rendah.

(2 markah)

(c) Kirakan frekuensi potong litar jika nilai-nilai $L = 4.5mH$, $C = 25\mu F$ dan $R = 100k\Omega$.

(8 markah)

(d) Senaraikan dua kelebihan dan dua kekurangan penapis pasif.

(5 markah)

S5 (a) Nyatakan definisi bagi Rangkaian Salingan.

(2 markah)

(b) Tentukan parameter galangan bagi rangkaian π dalam Rajah S5(b).

(8 markah)

(c) Dapatkan parameter lepasan bagi rangkaian dalam Rajah S5(c).

(10 markah)

S6 (a) Ungkapkan $f(t)$ sebagai Siri Fourier Trigonometri. Diberi fungsi $f(t)$ ialah gelombang berkala dengan tempoh T_0.

(2 markah)

(b) Gelombang berkala segitiga dalam Rajah S6(b(i)) disuap kepada kemasukan litar RC dalam Rajah S6(b(ii)). Pekali Fourier bagi masukan tersebut diberi oleh:

$$a_0 = 0 \qquad a_n = 0 \qquad b_n = \frac{160}{(n\pi)^2}\sin\left(n\frac{\pi}{2}\right)$$

di mana nilai $T_0 = 2\pi$ ms, $R = 10\,\text{k}\Omega$ dan $C = 50\,\text{nF}$.

(i) ungkapkan $v_0(t)$ dalam bentuk $v_i(t)$.

(2 markah)

(ii) dapatkan empat sebutan bukan sifar yang pertama dalam bentuk Siri Fourier bagi keluaran, $v_0(t)$.

(14 markah)

(iii) berdasarkan kepada jawapan anda dalam bahagian b(ii), apakah yang dapat anda simpulkan mengenai magnitud n harmonik apabila $n \to \infty$.

(2 markah)

S7 (a) Nyatakan definisi bagi Jelmaan Fourier.

(2 markah)

(b) Rujuk Jadual S7 dan Rajah S7(b) dan untuk soalan 7(b).

Voltan kemasukan untuk litar dalam Rajah S7(b) ialah $v_i(t) = 30e^{-|t|}$ V.

(i) berpandukan kepada definisi Jelmaan Fourier dalam bahagian S7(a), dapatkan Jelmaan Fourier bagi kemasukan, $v_i(t)$.

(6 markah)

(ii) dapatkan $v_o(t)$ jika nilai rintangan bagi perintang R1 dan R2 masing-masing adalah 20Ω dan 80Ω, manakala nilai kapasitor C ialah 0.125 F.

(9 markah)

(iii) ungkapkan rangkap pindah bagi litar dalam bentuk R1, R2 dan C. Berdasarkan kepada rangkap pindah tersebut, apakah yang dapat anda ulas mengenai kelakuan litar apabila nilai frekuensi berubah?

(3 markah)

SOALAN DALAM BAHASA INGGERIS.

Q1 Please use the Table Q1 for your reference.

(a) Determine the Laplace transform of the following function:

(i) $f(t) = e^{-3t}\sin(9t-5)$

(ii) $f(t) = 3t^2u(t) + e^{-5(t-3)}u(t-3)$

(iii) $f(t) = \sinh 5(t-2)$

(iv) $f(t) = \sin 4t[u(t) - u(t-\pi)]$

(8 marks)

(b) Obtain the Laplace transforms of the functions in Figure Q1(b(i)) and Figure Q1(b(ii)).

(7 marks)

(c) Determine the inverse Laplace transform of each of the following functions:

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

(2 marks)

(ii) $F(s) = \frac{3s+1}{(s+4)}$

(3 marks)

Q2 (a) Refer to the circuit Figure Q2 (a),

(i) draw the circuit diagram for $t < 0$ and $t > 0$.

(1 mark)

(ii) calculate the damping factor, α and the resonant frequency, ω_0.

(2 marks)

(iii) determine the roots of the characteristic equation, s_1 and s_2.

(2 marks)

(iv) find the values of $i(0)$, $v(0)$ and $\frac{dv(0)}{dt}$.

(4 marks)

(v) determine the type of the response for the circuit based on the answer obtained in part Q2(ii).

(1 mark)

(b) Give definition of the term Convolution.

(2 marks)

(c) Refer to the circuit Figure Q2(c),

(i) draw the fold diagram of signal $x_1(t)$ at y-axis.

(1 mark)

(ii) determine the convolution of the two signals $x_1(t)$ and $x_2(t)$ for $0 < t < 4$. Graphically, show the convolution diagram of the two signals.

(7 marks)

Q3 (a) Figure Q3(a) shows the second order low-pass circuit. Given that the value of the resistance, R is 2.828 kΩ and transfer function of the circuit is

$$H(s) = \frac{I_{out}(s)}{I_{in}(s)} = \frac{1}{4\times10^{-8}s^2 + 2.828\times10^{-4}s + 1}.$$

Based on the transfer function,

(i) determine the values of ζ and ω_n.

(4 marks)

(ii) sketch the Bode Plot of magnitude for the transfer function, shows the effect of damping ratio, ζ at the magnitude response.

(4 marks)

(iii) find the values of L and C for the circuit.

(4 marks)

(b) Figure Q3(b) shows the current versus frequency for the RLC series circuit. Given that the values for ω_0= 50000 rad/s, ω_1 = 49000 rad/s and ω_2 = 51000 rad/s. Based on the graph,

(i) determine the Bandwidth, Bw and Quality factor, Q.

(4 marks)

(ii) design the series RLC circuit and determined the value of R and C for the circuit design. Use L = 1 mH in your design.

(4 marks)

Q4 Figure Q4 shows a passive filter circuit.

(a) Find the transfer function.

(5 marks)

(b) Prove that the circuit is a low pass filter.

(2 marks)

(c) Calculate the cutoff frequency if L = 4.5mH, C = 25μF and R = 100kΩ.

(8 marks)

(d) List two advantages and two disadvantages of passive filter.

(5 marks)

Q5 (a) State the definition of Reciprocal Network.

(2 marks)

(b) Determine the impedance parameters of the π-Network in Figure Q5(b).

(8 marks)

(c) Find the admittance parameters of the network shown in Figure Q5(c).

(10 marks)

Q6 (a) Given that $f(t)$ is a periodic function with period, T_0. Express $f(t)$ as a trigonometric Fourier series.

(2 marks)

(b) The periodic triangular wave in Figure Q6(b(i)) is applied to the RC circuit shown in Figure Q6(b(ii)). The Fourier coefficients of the input are:

$$a_0 = 0 \qquad a_n = 0 \qquad b_n = \frac{160}{(n\pi)^2}\sin\left(n\frac{\pi}{2}\right)$$

The values of $T_0 = 2\pi$ ms, $R = 10\,\text{k}\Omega$ and $C = 50\,\text{nF}$.

(i) Express $v_0(t)$ in terms of $v_i(t)$.

(2 marks)

(ii) Find the first four nonzero terms in the Fourier series of $v_0(t)$.

(14 marks)

(iii) Based on your result in part b(ii), what can you conclude about the magnitude of the n^{th} harmonic as $n \to \infty$.

(2 marks)

Q7 (a) State the definition of Fourier Transform.

(2 marks)

(b) Referring to Table Q7 and Figure Q7(b) for Question 7(b).

The input voltage in the circuit in Figure Q7(b) is $v_i(t) = 30e^{-|t|}$ V.

(i) by using the definition of Fourier Transform in part Q7(a), find the Fourier Transform of $v_i(t)$.

(6 marks)

(ii) find $v_0(t)$ if the values of resistors R1 and R2 are 20Ω and 80 Ω respectively, while the value of capacitor C is 0.125 F.

(9 marks)

(iii) express the transfer function of the circuit in terms of R1, R2 and C. From this transfer function, what can you say about the behaviour of the circuit when the frequency is varied?

(3 marks)

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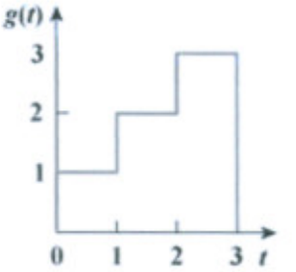
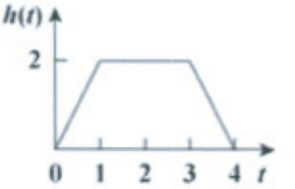
Jadual S1 / Table Q1

No.	f(t)	F(s)
1.	$\delta(t)$	1
2.	$u(t)$	$1/s$
3.	$tu(t)$	$1/s^2$
4.	$t^n u(t)$	$(n!)/s^{n+1}$
5.	$e^{-at} u(t)$	$1/(s+a)$
6.	$\sin\omega t\, u(t)$	$\omega/(s^2+\omega^2)$
7.	$\cos\omega(t)\, u(t)$	$s/(s^2+\omega^2)$
8.	$f(t-T)$	$e^{-Ts}F(s)$
9.	$e^{-at} f(t)$	$F(s+a)$



Rajah S1(b(i)) / Figure Q1(b(i))



Rajah S1(b(ii)) / Figure Q1(b(ii))

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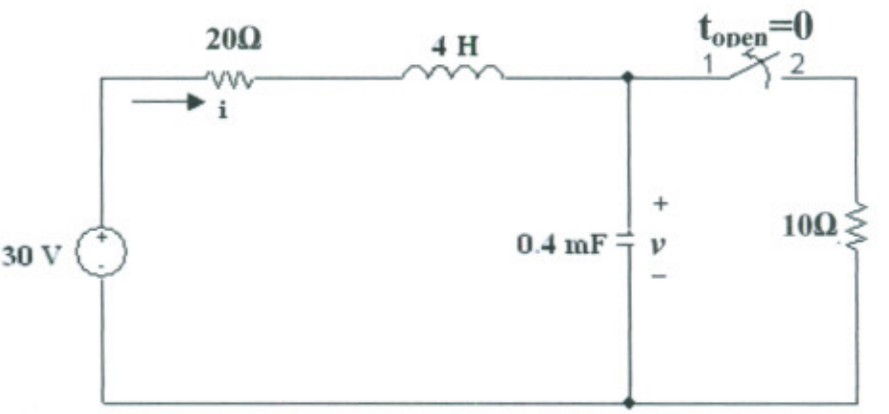
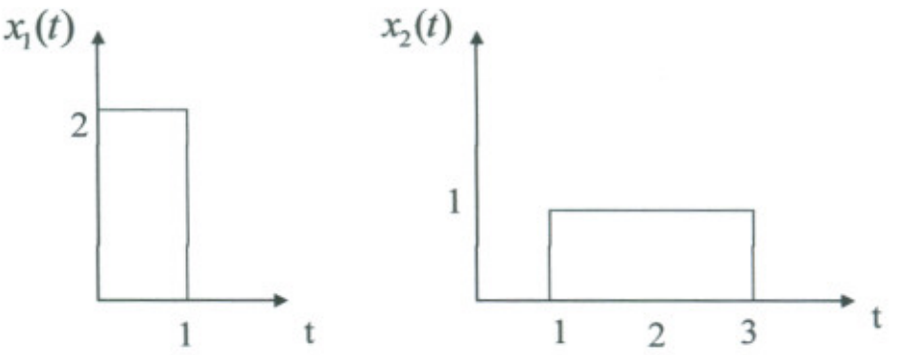


Rajah S2(a) / Figure Q2(a)



Rajah S2(c) / Figure Q2(c)

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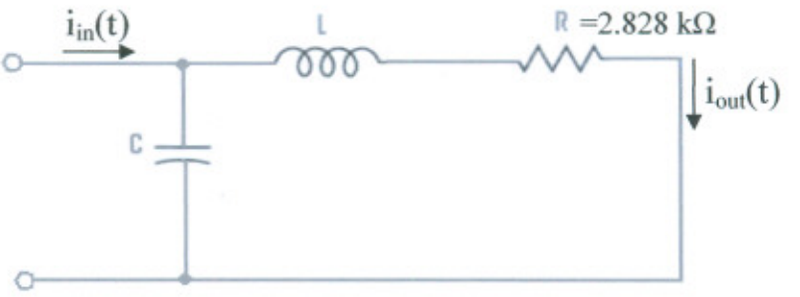
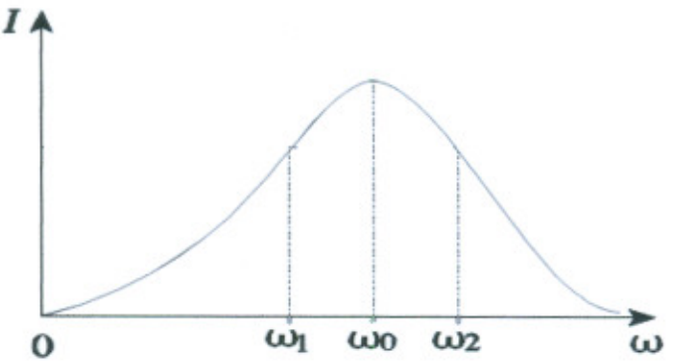
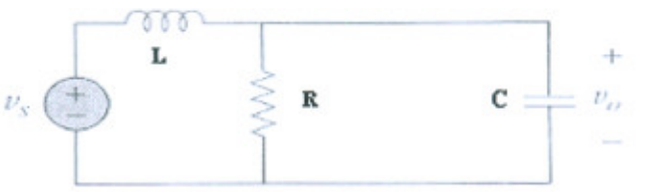


Rajah S3(a) / Figure Q3(a)



Rajah S3(b) / Figure Q3(b)



Rajah S4 / Figure Q4

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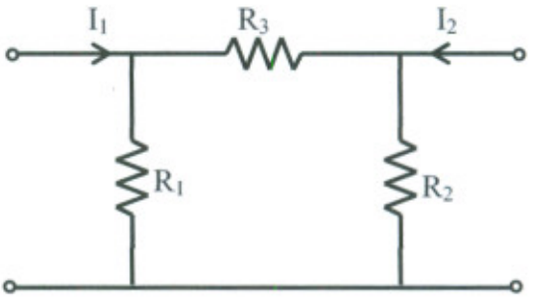
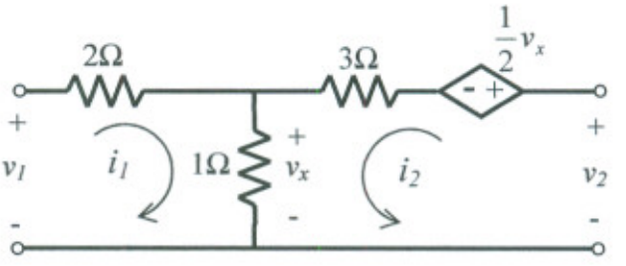


Rajah S5(b) / Figure Q5(b)



Rajah S5(c) / Figure Q5(c)

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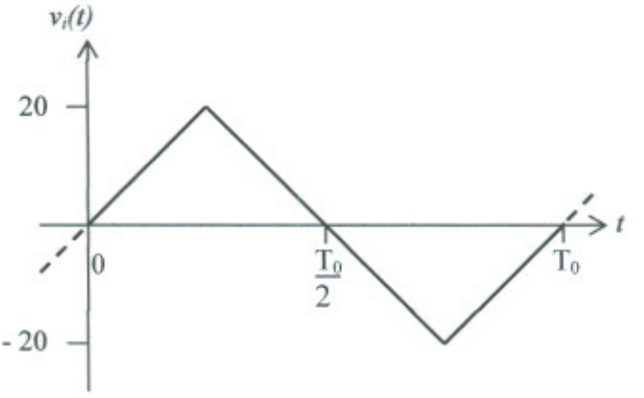
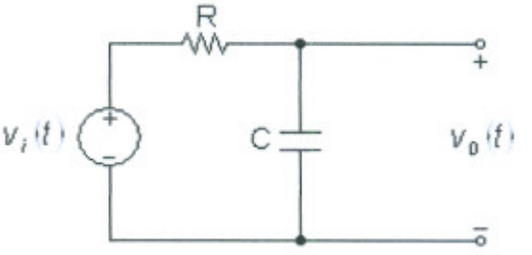


Rajah S6(b(i)) / Figure Q6(b(i))



Rajah S6(b(ii)) / Figure Q6(b(ii))

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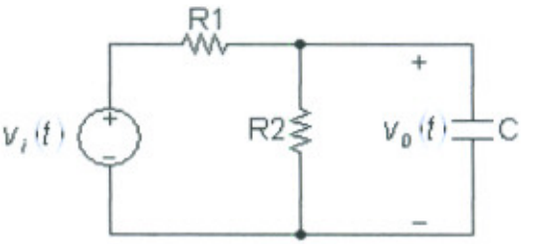
Jadual S7 / Table Q7

JENIS / TYPE	$f(t)$	$F(\omega)$
Dedenyut / Impulse	$\delta(t)$	1
Pemalar / Constant	A	$2\pi A\delta(\omega)$
Signum	$\text{sgn}(t)$	$2/j\omega$
Step	$u(t)$	$\pi\delta(\omega)+1/j\omega$
Eksponen masa positif / Positive-time exponential	$e^{-at}u(t)$	$1/(a+j\omega), a>0$
Eksponen masa negatif / Negative-time exponential	$e^{at}u(-t)$	$1/(a-j\omega), a>0$



Rajah S7(b) / Figure Q7(b)