UNIVERSITI SAINS MALAYSIA

First Semester Examination

2013/2014 Academic Session

December 2013/January 2014

EEE 208 – CIRCUIT THEORY II
[TEORI LITAR II]

Duration : 3 hours

[Masa : 3 jam]

Please check that this examination paper consists of FOURTEEN (14) pages printed material and TEN (10) pages of Appendices before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi EMPAT BELAS (14) mukasurat bercetak beserta Lampiran SEPULUH (10) muka surat bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: This question paper consists of SIX (6) questions. Answer **FIVE** (5) questions. All questions carry the same marks.

[***Arahan:*** *Kertas soalan ini mengandungi ENAM (6) soalan. Jawab **LIMA** (5) soalan. Semua soalan membawa jumlah markah yang sama.]*

Answer to any question must start on a new page.

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

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

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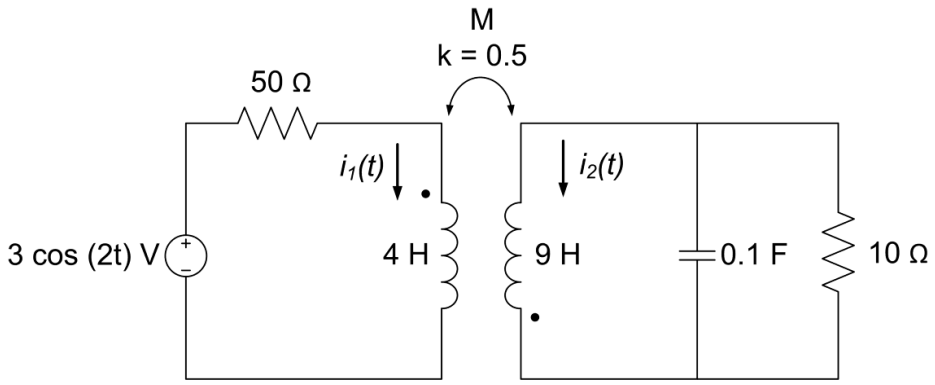
1. (a) Berpandukan litar dalam Rajah 1(a):
Based on the circuit in Figure 1(a):



Rajah 1(a)
Figure 1(a)

(i) Tentukan nilai induktans saling, *M*. *k* adalah pekali gandingan.
Determine the value of the mutual inductance, M. Note that k is the coefficient of coupling.

(10 markah/*marks)*

(ii) Lukis semula litar itu dalam domain pemfasa.
Redraw the circuit in the phasor domain.

(10 markah/*marks*)

(iii) Tentukan nilai arus $i_1(t)$.
Determine the current $i_1(t)$.

(15 markah/*marks*)

(iv) Tentukan nilai arus $i_2(t)$.
Determine the current $i_2(t)$.

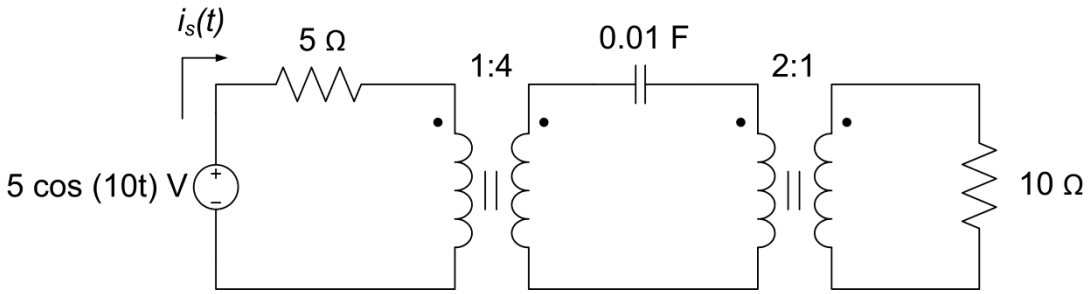
(15 markah/*marks*)

(v) Tentukan nilai tenaga yang tersimpan dalam pengaruh terganding pada masa t = 1s.

Determine the energy stored in the coupled inductors at time t = 1s.

(10 markah/*marks*)

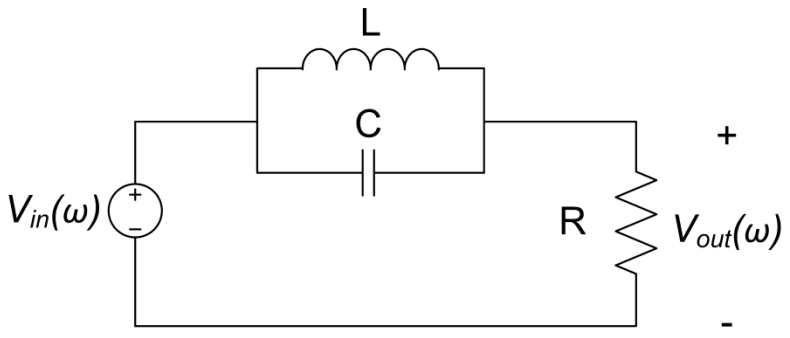
(b) Berpandukan litar dalam Rajah 1b), tentukan nilai arus $i_S(t)$.
Based on the circuit in Figure 1(b), determine the current $i_S(t)$.



Rajah 1(b)
Figure 1(b)

(40 markah/*marks*)

2. (a) Berpandukan litar dalam Rajah 2(a):
Based on the circuit in Figure 2(a):



Rajah 2(a)
Figure 2(a)

(i) Dengan menggunakan analisis pemfasa, tuliskan fungsi pindah $V_{out}(\omega)/V_{in}(\omega)$.

Using phasor analysis, write the transfer function $V_{out}(\omega)/V_{in}(\omega)$.

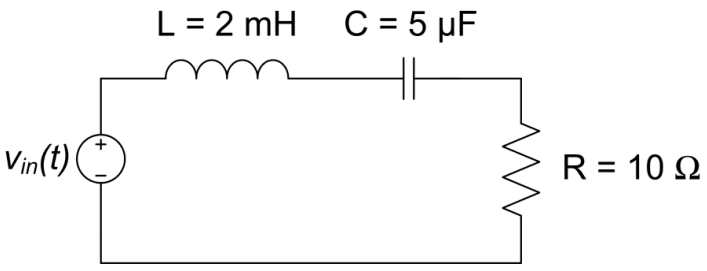
(20 markah/*marks*)

(ii) Tentukan sama ada litar itu mewakili penapis laluan rendah, laluan tinggi, lintasan jalur atau jalur batas. Tunjukkan jalan kerja anda.

Determine whether the circuit represents a lowpass, highpass, bandpass or bandstop filter. Show your work.

(20 markah/*marks*)

(b) Berpandukan litar dalam Rajah 2(b):
Based on the circuit in Figure 2 (b).



Rajah 2(b)
Figure 2(b)

(i) Kira nilai frekuensi resonan ω_0.
Calculate the resonant frequency ω_0.

(10 markah/*marks*)

(ii) Kira nilai faktor kualiti, Q.
Calculate the quality factor, Q.

(10 markah/*marks*)

(iii) Kira nilai lebar jalur, B.
Calculate the bandwidth, B.

(10 markah/*marks*)

(iv) Jika nilai kapasitor, C disekaligandakan, apakah nilai perubahan kepada faktor kualiti, Q?

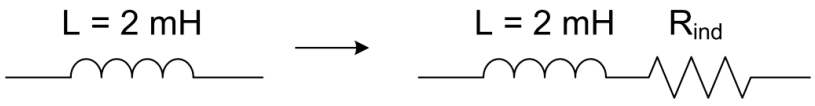
If the value of the capacitor, C is doubled, what is the resulting change in the quality factor, Q?

(15 markah/*marks*)

(v) Terangkan perubahan yang akan berlaku kepada faktor kualiti, jika pengaruh yang digunakan mempunyai kehilangan. Dalam kata lain, anggapkan bahawa pengaruh yang digunakan digantikan dengan pengaruh yang sama dan satu perintang yang disambungkan secara bersiri, seperti yang ditunjukkan dalam Rajah 2(b)(v).

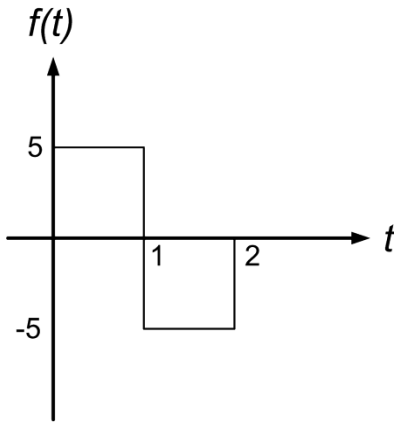
Explain how the quality factor will change if the inductor has some non-zero loss. In other words, assume that the inductor is replaced by a series combination of the same inductor with a resistor, as shown in Figure 2(b)(v).

(15 markah/*marks*)



Rajah 2(b)(v)
Figure 2(b)(v)

3. (a) Diberi *f(t)* dalam Rajah 3(a), cari jelmaan Laplace *F(s)*.
Given f(t) in Figure 3(a), find the Laplace transform F(s).

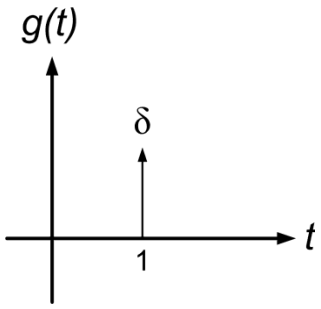


Rajah 3(a)
Figure 3(a)

(35 markah/*marks*)

(a) Jika isyarat *f(t)* dalam Rajah 3(a) dilingkarkan dengan isyarat *g(t)* dalam Rajah 3(b), lukiskan isyarat yang dikeluarkan.

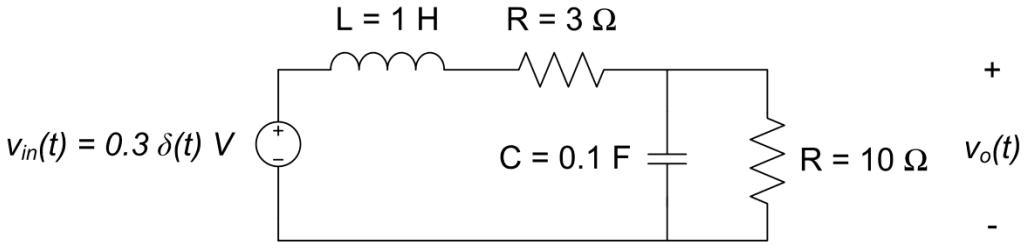
If the signal f(t) in Figure 3(a) is convolved with the signal g(t) in Figure 3(b), draw the resulting output signal.



Rajah 3(b)
Figure 3(b)

(15 markah/*marks*)

(b) Berpandukan litar dalam Rajah 3(c):
Based on the circuit in Figure 3(c):



Rajah 3(c)
Figure 3(c)

(i) Lukis semula litar itu dalam domain Laplace (domain-s).
Redraw the circuit in the Laplace domain (s-domain).

(10 markah/*marks*)

(ii) Tentukan nilai voltan $v_o(t)$. Anggapkan keadaan permulaan adalah sifar.
Determine the voltage $v_o(t)$. Assume zero initial condition.

(40 markah/*marks*)

4. Di dalam sistem penataan bunyi seperti Rajah 4(a)(i), sebuah isyarat berterusan seperti Rajah 4(a)(ii) dihasilkan oleh sistem A dan disalurkan ke penuras ideal. Sebuah gelombang segiempat s(t) dirambatkan ke dalam penuras laluan rendah fungsi pindah $|H(\omega)|$ dengan ω_c=x rad/s, sebagaimana yang ditunjukkan di Rajah 4(a)(iii). Hasil keluaran dari penuras laluan rendah, S(t) memerlukan komponen harmonik frekuensi terendah (termasuk komponen dc) isyarat s(t).

In a sound system shown in Figure 4(a)(i), a continuous signal shown is in Figure 4(a)(ii) produced from that system A and passes through a filter , a square wave signal s(t) (Figure 1(i)) propagates into an ideal Low-Pass Filter with transfer function $|H(\omega)|$ with ω_c=x rad/s, as shown in Figure 4(a)(iii) . The output through the filter, S(t) requires the lowest frequency harmonic component (including dc component) of signal s(t).

(a) Cadangkan respon $|H(\omega)|$ ideal dan julat ω_c untuk penuras laluan-rendah.

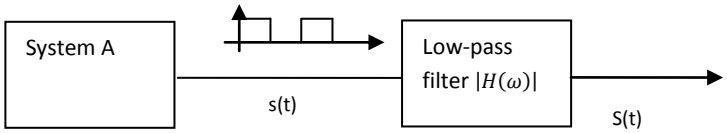
Propose the ideal $|H(\omega)|$ response and the range for ω_c for the low-pass filter.

(80 markah/*marks*)

(b) Terangkan dengan ringkas tanpa kiraan, bagaimana kesan isyarat keluaran jika penuras itu bertindak seperti di Rajah 4(b) dengan ω_c yang sama.

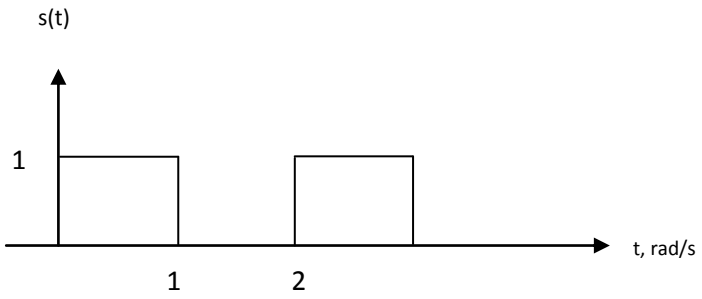
Explain briefly without calculation, how does the output signal be affected if the filter behaves according to Figure 4(b) with the same ω_c.

(20 markah/*marks*)



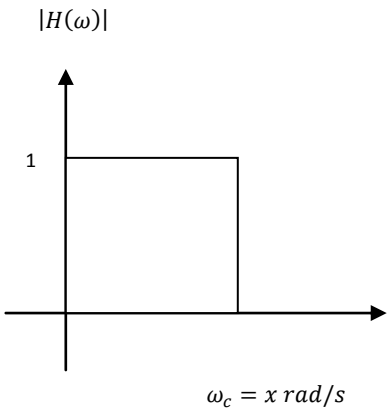
Rajah 4(a)(i) Sistem bunyi menghasilkan isyarat s(t)

Figure 4(a)(i) Sound system producing signal s(t)



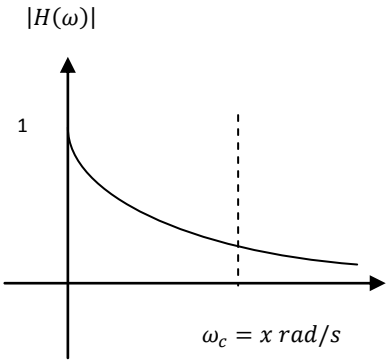
Rajah 4(a)(ii) Isyarat berterusan s(t)

Figure 4(a)(ii) Continuous Signal, s(t)



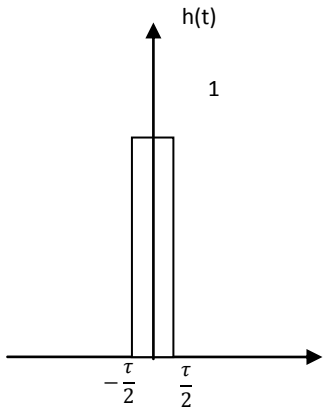
Rajah 4(a)(iii) Fungsi pindah penuras laluan-rendah *ideal*

Figure 4(a)(iii) Low-pass filter ideal Transfer function



Gambarajah 4(b) Fungsi pindah penuras laluan-rendah

Figure 4(b) Low-pass filter Transfer function



Rajah 5(a) Pulsa Segiempat

Figure 5(a) Single rectangular pulse

5. Dari Rajah 5(a), sebuah pulsa segiempat mempunyai lebar τ dan ketinggian A = 1.

From Figure 5(a), a single rectangular pulse has a width τ and height A = 1.

(c) Bincangkan perbezaan spektrum antara τ=2 dan τ=4 menggunakan Transformasi Fourier.

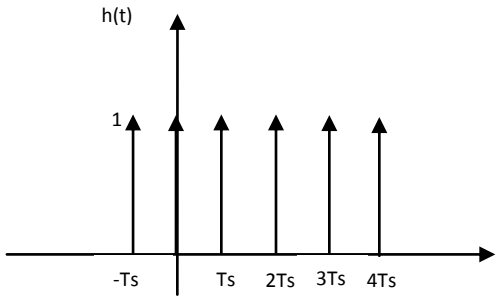
Discuss the spectral difference between τ=2 and τ=4 using Fourier transform.

(50 markah/*marks*)

(b) Jika pulsa segiempat bertindak sebagai leretan pulsa seperti Rajah 5(b), tunjukkan keluaran isyarat (bagi 0, Ts, 2Ts, 3Ts dan 4Ts) dengan menggunakan Frekuensi Nyquist, f_s , untuk masukan gelombang sin iaitu g(t) = sin ωt, yang mana f=5KHz, W=10KHz. Bagi memastikan isyarat diperolehi semula tanpa kehilangan informasi dengan mengikut frekuensi persampelan $f_s = 2$W, yang mana W adalah komponen frekuensi maksimum untuk isyarat yang disampel.

If the rectangular pulse behaves as a pulse train shown in Figure 5(b), demonstrate the output of the signal (for 0, Ts, 2Ts, 3Ts and 4Ts) using Nyquist Frequency, f_s for an input sine wave of g(t) = sin ωt where f=5KHz, W=10KHz. Ensure a full recovery of the signal at the receiving end without loss of information by following the sampling frequency of $f_s = 2W$ where W is maximum frequency component for signal to be sampled.

(50 markah/*marks*)



Rajah 5(b) Leretan pulsa untuk pulsa segiempat

Figure 5(b) Impulse train for the rectangular pulse

6. Sebuah transistor menggunakan litar *common-emitter*
A transistor has the following common-emitter circuit:

$h_{ie} = 2.640\Omega$

$h_{re} = 2.6 \times 10^{-4}$

$h_{fe} = 72$

$h_{oe} = 16\mu S$

$R_L = 100k\Omega$

(a) Lukiskan rangkaian hibrid transistor
Draw the transistor hybrid network

(20 markah/*marks*)

(b) Apakah pembesaran arus transistor berkenaan?
What is the current gain of the transistor?

(20 markah/*marks*)

(c) Berapakah nilai gandaan desibelnya?
How many decibel gain for this?

(10 markah/*marks*)

(d) Rangkaian transistor ini digabungkan secara lata dengan rangkain berlainan dengan nilai $T = \begin{bmatrix} 4 & 20\Omega \\ 0.1S & 2 \end{bmatrix}$. Paparkan keseluruhan nilai T_{total} bagi kesemua rangkaian terbabit.

The transistor network is cascaded with another different network having $T = \begin{bmatrix} 4 & 20\Omega \\ 0.1S & 2 \end{bmatrix}$. *Present the overall* T_{total} *network representing all networks.*

(50 markah/*marks*)

oooOooo