UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2008/2009

NAMA MATAPELAJARAN	: ANALISIS & SINTESIS RANGKAIAN ELEKTRIK
KOD MATAPELAJARAN	: BEE 3113
KURSUS	: 2 BEE
TARIKH PEPERIKSAAN	: APRIL/MEI 2009
JANGKA MASA	: 2 ½ JAM
ARAHAN	: KERTAS SOALAN INI TERBAHAGI KEPADA **DUA (2)** BAHAGIAN. **BAHAGIAN A**: SILA JAWAB **TIGA (3)** DARIPADA **LIMA (5)** SOALAN. **BAHAGIAN B** : SILA JAWAB **SATU (1)** DARIPADA **DUA (2)** SOALAN

KERTAS SOALAN INI MENGANDUNGI 13 MUKA SURAT.

PART A: ANSWER ONLY THREE (3) FROM FIVE (5) QUESTIONS GIVEN.

Q1 Please use Table Q1 for your reference.

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

(i) $f(t) = \sin(\omega t + 90^o)$

(ii) $f(t) = e^{-6t} \sin 4t\, u(t)$

(iii) $f(t) = te^{2t} \sin 2t\, u(t)$

(iv) $f(t) = 2t^2 u(t) + 5e^{-3t-6} u(t-2)$

(v) $f(t) = 20\cos 4(t-1)\, u(t)$

(10 marks)

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

(10 marks)

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

(i) $F(s) = \dfrac{2se^{-\pi s}}{s^2 + 1}$

(2 marks)

(ii) $F(s) = \dfrac{8s^3}{s(s+1)}$

(3 marks)

Q2 (a) For the circuit in Fig. Q2(a),

(i) Find the initial voltage, $v(0^-)$ and current, $i(0^-)$ at t <0.

(3 marks)

(ii) Draw the circuit diagram at t=0.

(2 marks)

(iii) Find $v_o(t)$ at t>0 in the circuit.

(6 marks)

(iv) Identify the output voltage in term of force and natural response.

(1 mark)

(b) The transfer function for a network is $H(s) = \dfrac{s+10}{s^2+4s+8}$.

(i) Sketch the pole-zero plot of H(s).

(3 marks)

(ii) Determine the type of damping exhibited by the network. Justify if this is a stable network.

(2 marks)

(c) A system has a transfer function, $h_1(t) = u(t-1) - u(t-3)$ and an input of $x(t) = u(t) - u(t-1)$. Determine the output function, $y(t)$ using convolution integral. Show all the diagrams and steps.

(8 marks)

Q3 (a) A series RLC circuit with an input voltage of $5V \angle 0^0$ is to be designed to meet the following specifications:

A peak current of 500mA at resonance
A bandwidth of 120 Hz
A resonant frequency of 8400 Hz

(i) Find the values of resistance,*R*, inductance, *L*, and capacitance,*C* in the circuit.

(8 marks)

(ii) Determine the quality factor,Q of the circuit

(3 marks)

(b) Based on Figure Q3 (b),

(i) Determine the transfer function of voltage gain, $\frac{V_o}{V_i}$

(4 marks)

(ii) Sketch the bode plot of voltage gain A_{vdB} versus frequency

(8 marks)

(iii) State the application of the circuit based on the frequency response

(2 marks)

Q4 (a) Given a filter configuration shown as Figure Q4(a),

(i) Find the transfer function, $\frac{V_o(s)}{V_s(s)}$

(5 marks)

(ii) Determine the type of filter

(2 marks)

(iii) If the Band Stop Filter is a standard series resonance circuit, Calculate the center frequency and bandwidth. Use L = 100mH, C = 10 μF and R = 100kΩ

(8 marks)

(b) For an emergency situation, an engineer needs to make an *RC* high-pass filter. He has one 10-pF capacitor, one 30-pF capacitor, one 1.8 kΩ resistor, and one 3.3-kΩ resistor available. Find the greatest cutoff frequency possible using these elements.

(10 marks)

Q5 (a) A two port network has the following ABCD parameter:

$$\text{ABCD} = \begin{bmatrix} 4 & 20\Omega \\ 0.1\,\text{S} & 2 \end{bmatrix}$$

The network is driven by a 50Volt dc source whose internal resistance is 10Ω. The output port is connected to the variable load resistance, R_L.

(i) State the condition for maximum power transfer to the load

(2 marks)

(ii) Determine the resistance load, R_L for maximum power transfer

(7 marks)

(iii) Calculate the power maximum power transfer

(7 marks)

(b) Find the admittance parameters of the circuit in Figure Q5(b).

(9 marks)

PART B: ANSWER ONE (1) QUESTION ONLY.

Q6 (a) Given the waveform in Figure Q6(a), determine the type of symmetry that exists if the origin is selected at:

(i) point t_1

(ii) point t_2

(4 marks)

(b) For the periodic functions in Figure Q6(b), determine the following:

(i) Fundamental frequency, ω_o in radians per second

(2 marks)

(ii) The exponentional Fourier coefficient,Cn

(7 marks)

(iii) Voltage equation,*V(t)* as a Fourier series

(2 marks)

(c) The voltage and current at the terminals of a network are given as:

$$v = 50 + 200\cos(500t + 45^\circ) + 60\sin 1000t \ V,$$

$$i = 5 + 5\sin(500t + 75^\circ) + 8\cos(1000t - 30^\circ) \ A$$

Known that the current is in the direction of the voltage drop across the terminals,

(i) Find the average power at the terminals

(4 marks)

(ii) Obtain the rms value of the voltage, V_{rms}

(3 marks)

(iii) Determine the rms value of the current, I_{rms}

(3 marks)

Q7 (a) The Fourier Series for a function is given by equation:

$$f(t) = \sum_{\substack{n=-1 \\ n=odd}}^{\infty} \frac{-2}{n\pi} \sin\frac{n\pi}{2} \cos(n\omega_0 t) + \frac{6}{n\pi} \sin(n\omega_0 t)$$

(i) Find the first four terms of the amplitude and phase spectra for the signal

(4 marks)

(ii) Plot the amplitude and phase spectra found in part (a)(i)

(4 marks)

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

(2 marks)

(b) A voltage of $v(t)=100\cos\omega t + 30\cos(3\omega t + 60)$ is connected to the circuit shown in Figure Q7 (b). What will be the current through 500 Ω resistor, if the fundamental frequency is 10^4 rad /s?

(7 marks)

(c) A network in Figure Q7(c) represents a simple low pass filter. An input voltage, $v_i(t) = 5e^{-2t}u(t)$ is applied to the newtork. Find the Fourier transform of the output, $v_o(t)$.

(8 marks)

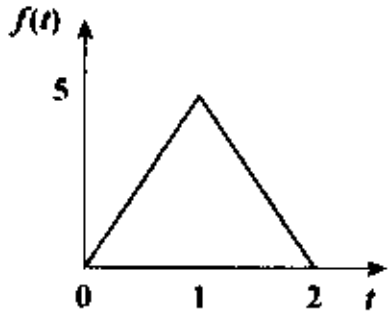

Figure Q1(b)(i)

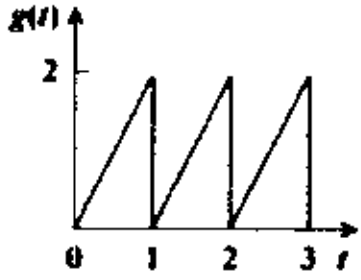

Figure Q1(b)(ii)

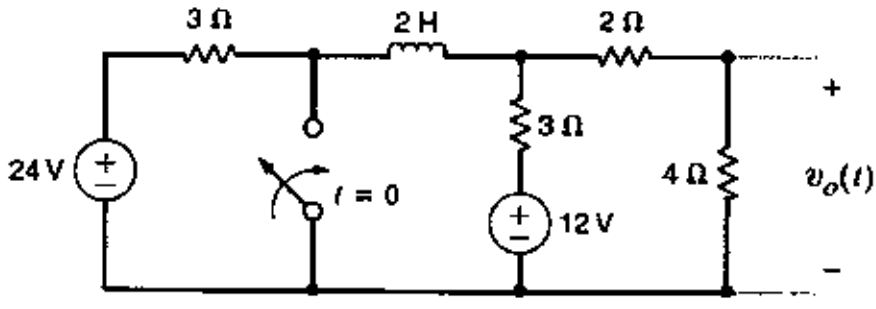

Figure Q2(a)

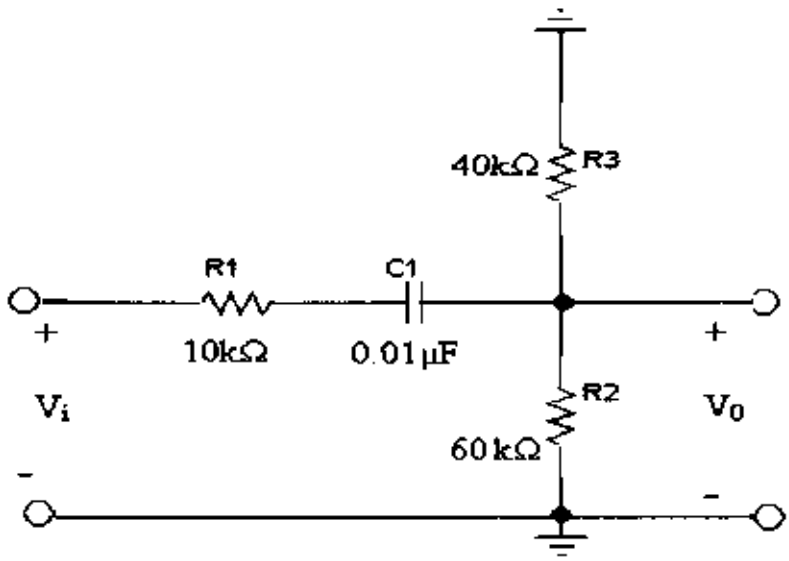

Figure Q3(b)

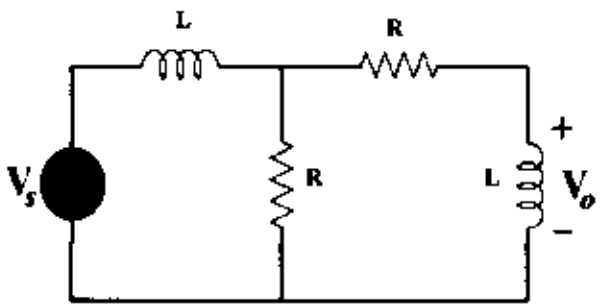

Figure Q4(a)

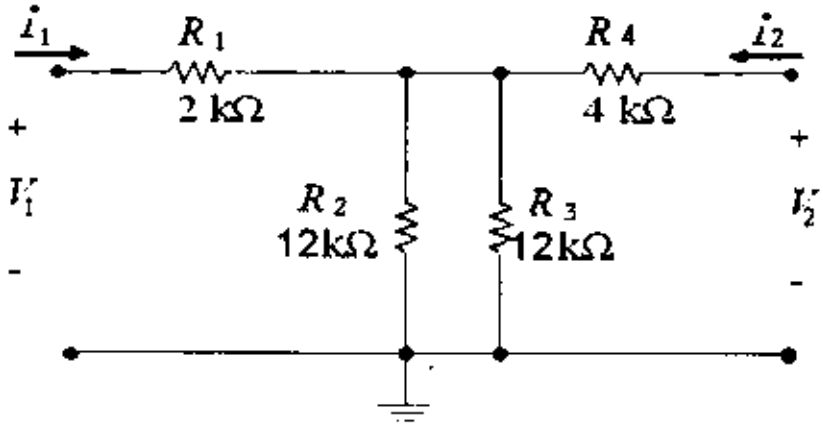

Figure Q5(b)

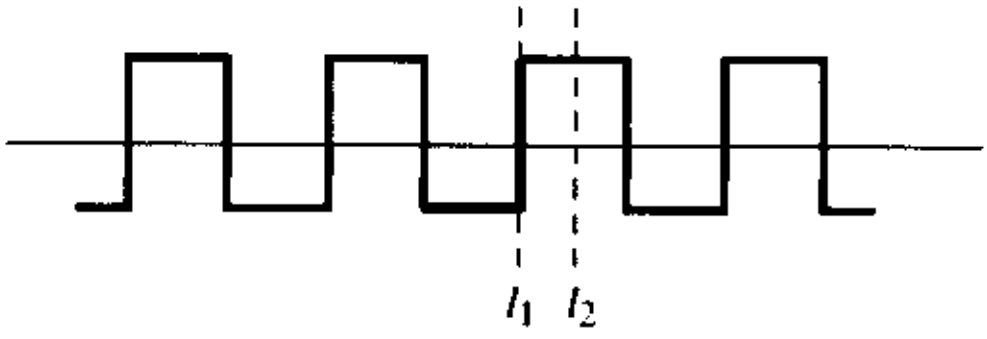

Figure Q6(a)

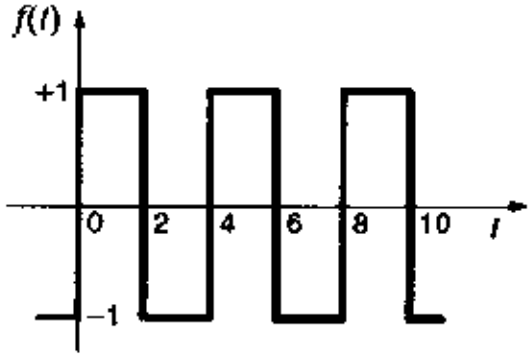

Figure Q6(b)

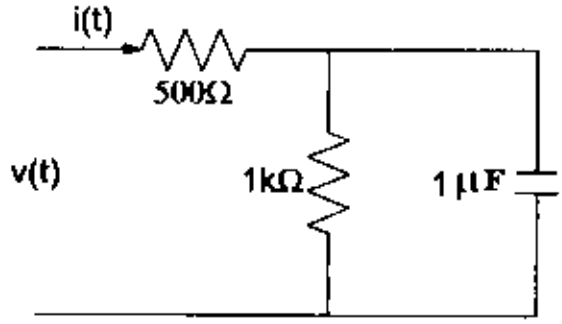

Figure Q7(b)

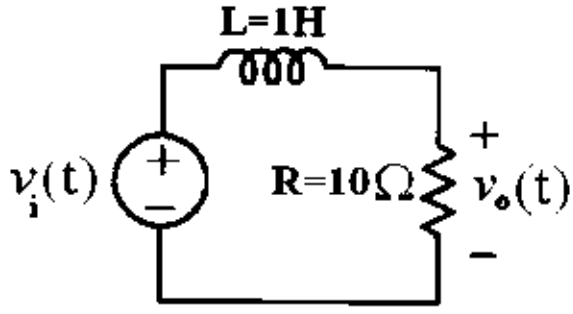

Figure Q7(c)

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Table 1: Properties of Laplace Transform

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(at)	$\frac{1}{a}F(\frac{s}{a})$
9.	$e^{-at} f(t)$	F(s+a)
10.	f(t-a) u(t-a)	$e^{-as}F(s)$
11.	$\frac{df}{dt}$ $\frac{d^n f}{dt^n}$	$sF(s)-f(0^-)$ $s^n F(s)-s^{n-1}f(s)$ $-s^{n-2}f'(0)..-f^{(n-1)}(0^-)$
12.	$\int_0^t f(t)dt$	$\frac{1}{s}F(s)$
13.	tf(t)	$-\frac{d}{ds}F(s)$
14.	$\frac{f(t)}{t}$	$\int_s^\infty F(s)ds$
15.	f(t+nT)	$\frac{F_1(s)}{1-e^{-sT}}$
16.	f(0)	$\lim_{s\to\infty} sF(s)$
17.	$f(\infty)$	$\lim_{s\to 0} sF(s)$
18.	$f_1(t)*f_2(t)$	$F_1(s).F_2(s)$

Table 2: Trigonometric Integrals

$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$ $\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$
$\int \sin n\omega_o t \ dt = 0$
$\int \cos n\omega_o t \ dt = 0$
$\int \sin n\omega_o t \ \cos m\omega_o t \ dt = 0$
$\int \sin n\omega_o t \ \sin m\omega_o t \ dt = 0, \quad (m \neq n)$
$\int \cos n\omega_o t \ \cos m\omega_o t \ dt = 0, \quad (m \neq n)$
$\int \sin^2 n\omega_o t \ dt = T/2$
$\int \cos^2 n\omega_o t \ dt = T/2$

Table 3: Fourier Transform Pairs

Pair	$f(t)$	$F(\omega)$
1	$\delta(t)$	1
2	A	$2\pi A\delta(\omega)$
3	$\text{sgn}(t)$	$2/j\omega$
4	$u(t)$	$\pi\delta(\omega) + 1/j\omega$
5	$e^{-at}u(t)$	$1/(a + j\omega), a > 0$
6	$e^{at}u(-t)$	$1/(a - j\omega), a > 0$
7	$e^{-a\lvert t\rvert}$	$2a/(a^2 + \omega^2), a > 0$
8	$e^{j\omega_0 t}$	$2\pi\delta(\omega - \omega_0)$
9	$\cos(\omega_0 t)$	$\pi[\delta(\omega + \omega_0) + \delta(\omega - \omega_0)]$
10	$\sin(\omega_0 t)$	$j\pi[\delta(\omega + \omega_0) - \delta(\omega - \omega_0)]$