UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018

COURSE NAME	:	TRANSFORM CIRCUIT ANALYSIS
COURSE CODE	:	BEF 22803
PROGRAMME CODE	:	BEV
EXAMINATION DATE	:	DECEMBER 2017 / JANUARY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Sketch the waveform of the following functions:

(i) $x(t) = \begin{cases} 0 & t < 2 \\ t+2 & t \geq 2 \end{cases}$

(2 marks)

(ii) $f(t) = 2u(t-2) + 3u(t-4) - 6u(t-6)$

(3 marks)

(b) Determine the mathematical function *f(t)* as shown in **Figure Q1(b)**. (hint: **not** the piecewise function)

(3 marks)

(c) System *h(t)* is given with an input signal of $y_i(t)$. Determine the piecewise function of signal output $y_o(t) = h(t) * y_i(t)$ using convolution method. The signals are given in **Figure Q1(c)**. Fold the input signal to solve this question.

(12 marks)

Q2 (a) Find the Laplace transformation of following functions by referring to the Laplace Transform Table:

(i) $y_1(t) = 2e^{8t}u(t)$

(2 marks)

(ii) $y_2(t) = 2u(t-3) - 4u(t-6)$

(4 marks)

(iii) $y_3(t) = cos2(t-4)u(t-4)$

(4 marks)

(b) Find the inverse Laplace transformation of the following function by referring to Laplace Transform tables:

(i) $F_1(s) = 3 + \frac{6}{s+6} - \frac{7s}{s^2+16}$

(5 marks)

(ii) $F_2(s) = \frac{s+10}{s^2-8s-20}$

(5 marks)

Q3 (a) Consider the circuit for **Figure Q3(a)**. Assume the circuit is in steady state prior to $t = 0$, determine i(t) for t > 0 s. (hint: switch is closed at t = 0).

(10 marks)

(b) The input. A circuit with the parallel RLC load is shown in **Figure Q3(b)**. Given the input current is $i_s(t) = 4u(t)$A, $v(0)$ =5V and $i(0)$ = -2A. Determine the function of $v(t)$ and $i(t)$ for C and L loads.

(10 marks)

Q4 (a) The input voltage for **Figure Q4(a)** is $v_i(t) = 2e^{-3t}u(t)$. Determine the output voltage of the capacitor, $v_o(t)$

(6 marks)

(b) The input current of the circuit in **Figure Q4(b)** is $i_i(t) = 10 \sin 2t\ A$. Using the Fourier transform method, determine the output current of the circuit, $i_o(t)$

(14 marks)

Q5 The input voltage $v(t)$ for **Figure Q5** is given in Fourier series expansion:

$$v(t) = 1 + \sum_{n=1}^{\infty} \frac{2(-1)^n}{1+n^2}(\cos(nt) - n \cdot sin(nt))$$

(a) Determine the total impedance of the circuit, Z_{total}

(3 marks)

(b) Calculate the output current for the inductor in time domain, $i_0(t)$

(10 marks)

(c) Calculate the rms value of the input voltage, V_{rms}

(7 marks)

-END OF QUESTIONS-

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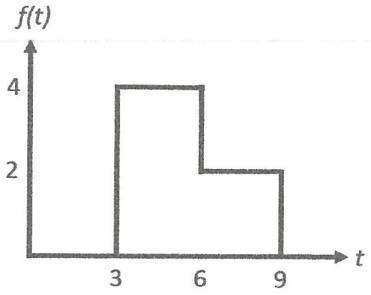

Figure Q1(b)

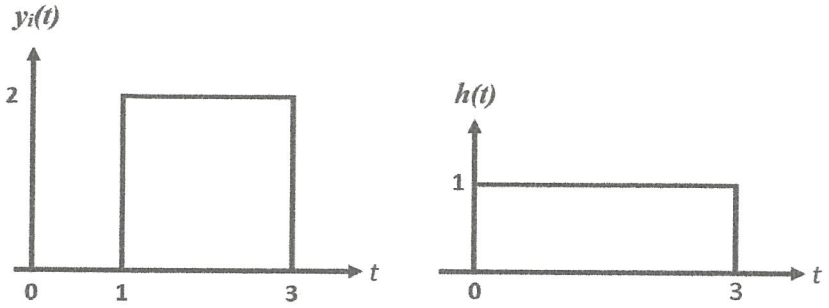

Figure Q1(c)

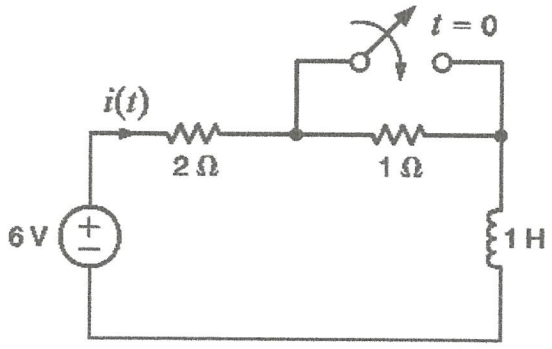

Figure Q3(a)

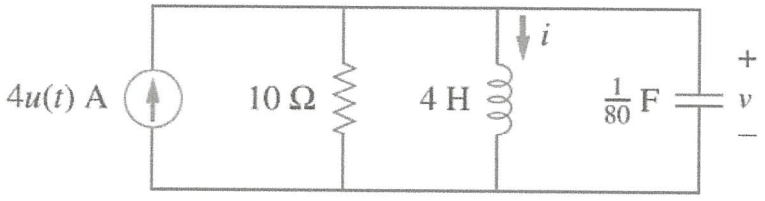

Figure Q3(b)

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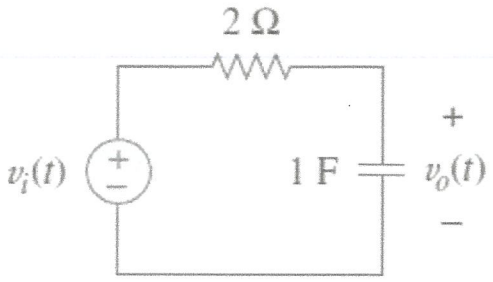

Figure Q4(a)

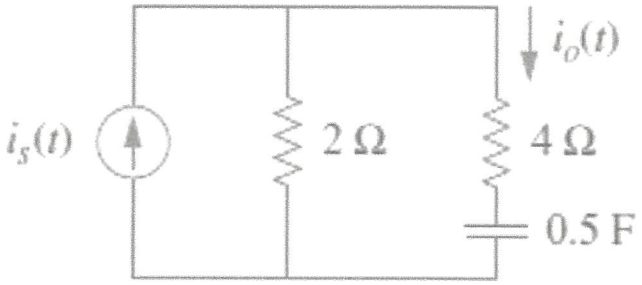

Figure Q4(b)

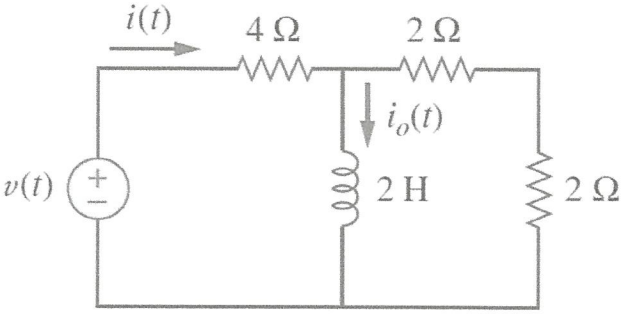

Figure Q5

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$$f(t) = a_0 + \sum_{n=1}^{\infty} (a_n \cos n\omega_0 t + b_n \sin n\omega_0 t)$$

$$f(t) = a_0 + \sum_{n=1}^{\infty} A_n \cos(n\omega_0 t + \phi_n)$$

$$A_n = \sqrt{a_n^2 + b_n^2}, \qquad \phi_n = -\tan^{-1}\frac{b_n}{a_n}$$

$$A_n \angle \phi_n = a_n - jb_n$$

TABLE 1: LAPLACE TRANSFORM PAIRS

$f(t)$	$F(s)$	$f(t)$	$F(s)$
$\delta(t)$	1		
$u(t)$	$\frac{1}{s}$	$\cos \omega t$	$\frac{s}{s^2 + \omega^2}$
e^{-at}	$\frac{1}{s + a}$	$\sin(\omega t + \theta)$	$\frac{s \sin\theta + \omega \cos\theta}{s^2 + \omega^2}$
t	$\frac{1}{s^2}$	$\cos(\omega t + \theta)$	$\frac{s \cos\theta - \omega \sin\theta}{s^2 + \omega^2}$
t^n	$\frac{n!}{s^{n+1}}$	$e^{-at} \sin \omega t$	$\frac{\omega}{(s + a)^2 + \omega^2}$
te^{-at}	$\frac{1}{(s + a)^2}$	$e^{-at} \cos \omega t$	$\frac{s + a}{(s + a)^2 + \omega^2}$
$t^n e^{-at}$	$\frac{n!}{(s + a)^{n+1}}$		
$\sin \omega t$	$\frac{\omega}{s^2 + \omega^2}$		

*Defined for $t \geq 0$; $f(t) = 0$, for $t < 0$.

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TABLE 2: LAPLACE TRANSFORM PROPERTIES

Property	$f(t)$	$F(s)$
Linearity	$a_1f_1(t) + a_2f_2(t)$	$a_1F_1(s) + a_2F_2(s)$
Scaling	$f(at)$	$\frac{1}{a}F\left(\frac{s}{a}\right)$
Time shift	$f(t-a)u(t-a)$	$e^{-as}F(s)$
Frequency shift	$e^{-at}f(t)$	$F(s+a)$
Time differentiation	$\frac{df}{dt}$	$sF(s) - f(0^-)$
	$\frac{d^2f}{dt^2}$	$s^2F(s) - sf(0^-) - f'(0^-)$
	$\frac{d^3f}{dt^3}$	$s^3F(s) - s^2f(0^-) - sf'(0^-) - f''(0^-)$
	$\frac{d^nf}{dt^n}$	$s^nF(s) - s^{n-1}f(0^-) - s^{n-2}f'(0^-) - \cdots - f^{(n-1)}(0^-)$
Time integration	$\int_0^t f(x)dx$	$\frac{1}{s}F(s)$
Frequency differentiation	$tf(t)$	$-\frac{d}{ds}F(s)$
Frequency integration	$\frac{f(t)}{t}$	$\int_s^\infty F(s)ds$
Time periodicity	$f(t) = f(t+nT)$	$\frac{F_1(s)}{1-e^{-sT}}$
Initial value	$f(0)$	$\lim_{s\to\infty} sF(s)$
Final value	$f(\infty)$	$\lim_{s\to 0} sF(s)$
Convolution	$f_1(t) * f_2(t)$	$F_1(s)F_2(s)$