

Question 1: (20%)

Please use Laplace transform to solve the electric current $i(t)$ in the following circuit, when the switch is closed at $t=0$ with $V_c(0)=1V$.

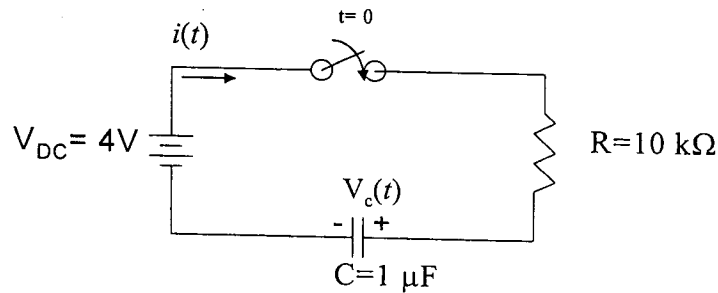


Figure Q1

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Question 2: (20%)

- (a) (10%) Please prove the following continuous-time Fourier transform property

$$x(t) * y(t) \xrightarrow{FT} X(j\omega)Y(j\omega),$$

if the Fourier transforms of $x(t)$ and $y(t)$ are $X(j\omega)$ and $Y(j\omega)$, respectively.

- (b) (10%) For a discrete-time signal $x[n]$ with its Z-transform $X(z)$, please prove the following Z-transform property

$$nx[n] \xrightarrow{Z} -z \frac{d}{dz} X(z).$$

Question 3: (20%)

- (a) (10%) For a continuous-time signal $x(t)$ with its Fourier transform $X(j\omega)$, please prove the following property

$$\frac{d}{dt} x(t) \xrightarrow{FT} j\omega X(j\omega).$$

- (b) (10%) Please find the Fourier transform of the following signal

$$y(t) = \frac{d}{dt} \left[e^{-2at} u(t) \right],$$

where $u(t)$ is the unit step function.

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Question 4: (20%)

Please determine the discrete-time sequence $x[n]$ of the following Z-transform

$$X(z) = \frac{(1+3z)(1-2z^{-1})}{1-4z^{-1}},$$

when $x[n]$ is a right-sided sequence.

Question 5: (20%)

Please see the following discrete-time circuit in Figure Q5. Please solve the general solution of output $y[n]$ with $y[n] = 0$ for $n < 0$ and the input $x[n] = u[n]$,

$$\text{where } u[n] = \begin{cases} 1, & \text{for } n \geq 0 \\ 0, & \text{for } n < 0 \end{cases}$$

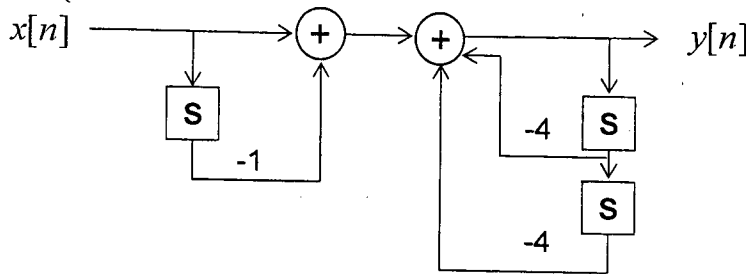


Figure Q5.

*Note: S is the delay operator.

參考用

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