PROBLEM:

The delay property of Fourier transform states that if $X(j\omega)$ is the Fourier transform of $x(t)$, the the Fourier transform of $x(t-t_d)$ is $e^{-j\omega t_d}X(j\omega)$, i.e.,

$$x(t-t_d) \Longleftrightarrow e^{-j\omega t_d}X(j\omega).$$

Use this property to find the Fourier transforms of the following signals:

(a) $x(t) = \delta(t-10)$

(b) $x(t) = \dfrac{\sin(5\pi(t-10))}{\pi(t-10)}$

(c) $x(t) = e^{-4t}u(t) - e^{-4t}u(t-10) = e^{-4t}u(t) - e^{-40}e^{-4(t-10)}u(t-10)$

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.

SOLUTION

a) $\delta(t-10) \Longleftrightarrow X(j\omega) = e^{-j10\omega}$

b) $\dfrac{\sin 5\pi t}{\pi t} \Longleftrightarrow X(j\omega) = [u(\omega+5\pi) - u(\omega-5\pi)]$

So: $\dfrac{\sin[5\pi(t-10)]}{\pi(t-10)} \Longleftrightarrow X(j\omega) = e^{-j10\omega}[u(\omega+5\pi) + - u(\omega-5\pi)]$

c) $e^{-4t}u(t) \Longleftrightarrow X(j\omega) = \dfrac{1}{4+j\omega}$

So: $e^{-4t}u(t) - e^{-40}e^{-4(t-10)}u(t-10) =$

$$= \frac{1}{4+j\omega} - e^{-40}e^{-j10\omega}\frac{1}{4+j\omega} =$$

$$= \frac{1 - e^{-(40+j10\omega)}}{4+j\omega}$$

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