PROBLEM:

(a) A continuous-time linear, time-invariant system has the impulse response

$$h(t) = \delta(t) + A\delta(t - \Delta).$$

Find the output of the system, $y(t)$, when the input is $x(t) = \sin(2000\pi t)$, $A = 1$, and $\Delta = 2.5\times 10^{-4}$. Express your answer as a single sinusoid.

$y(t) =$

(b) Now assume that the input signal is $x(t) = \sin(2000\pi t)$, i.e., that the sinusoid is now zero for $t < 0$. Find values for A and Δ that will permit the new output $y(t)$ to be *exactly* three periods of a 1000Hz sine waveform and zero thereafter.

$A =$	$\Delta =$

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

SOLUTION

(a) A continuous-time linear, time-invariant system has the impulse response

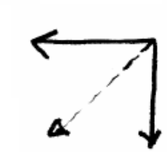
$$h(t) = \delta(t) + A\delta(t - \Delta).$$

Find the output of the system, $y(t)$, when the input is $x(t) = \sin(2000\pi t)$, $A = 1$, and $\Delta = 2.5 \times 10^{-4}$. Express your answer as a single sinusoid.

$$y(t) = \sin(2000\pi t) + \sin\left(2000\pi\left(t - \frac{1}{4000}\right)\right)$$

$$= \sin(2000\pi t) + \sin\left(2000\pi t - \frac{\pi}{2}\right)$$

$$= \sqrt{2}\sin\left(2000\pi t - \frac{\pi}{4}\right)$$



$\boxed{y(t) = \sqrt{2}\sin\left(2000\pi t - \frac{\pi}{4}\right)}$ $= \cos\left(2000\pi t - 3\frac{\pi}{4}\right)$

(b) Now assume that the input signal is $x(t) = \sin(2000\pi t)u(t)$, i.e., that the sinusoid is now zero for $t < 0$. Find values for A and Δ that will permit the new output $y(t)$ to be *exactly* three periods of a 1000 Hz sine waveform and zero thereafter.

3 PERIODS $\Longrightarrow$ $\Delta = 3\left(\frac{1}{1000}\right) = 3 \times 10^{-3}$

$A = -1$ WILL MAKE THE SUM ZERO FOR $t \geq \Delta$

$\boxed{A = -1}$ $\boxed{\Delta = 3 \times 10^{-3}}$

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