Problem 7.1
(a) \( x(t - 1) \), delay by 1.
(b) \( x(t + 0.5) \), advance by 0.5.
(c) \( \cos(t + 1.01) + \cos[2(t + 1.04)] \), advance by 1 with a little distortion.
(d) \( -x(t - 1) \), negate and delay by 1.
(e) \( e^j x(t - 1) \), scale by \( e^j \) and delay by 1 (note that \( h(t) \) is not real).
(f) \( x(t - 1) \), delay by 1 (note that in general the system will severely distort an input).

Problem 7.2
(a) The envelope is a sinc, and 2000 periods of the sinusoid fit under the center lobe of the sinc.
(b) \( x(t - 1) \), the entire signal picks up a group delay of 1.
(c) \( v(t - \tau) \cos[1000t - \phi] \), the envelope picks up a group delay of \( \tau \), while the sinusoid picks up a phase delay of \( \phi \) radians.

Problem 7.3

Problem 7.4
Problem 7.5
(a) 1: $H_1$; 2: $H_1$ and $H_2$; 3: $H_5$; 4: $H_3$.
(b) See below.
(c) Yes. $H_7(j\omega) = -H_1(j\omega)$ or $-H_2(j\omega)$ or $\frac{j\omega + 100}{10(j\omega - 10)}$ or $-\frac{j\omega + 100}{10(j\omega - 10)}$.
(d) See below.

Problem 7.6
(a) $50\frac{\sin 12.5\pi t}{\pi t} + 100\frac{\sin 6.25\pi t}{\pi t}\cos 93.75\pi t$
(b) $100\frac{\sin 25\pi t}{\pi t}$
(c) $200\frac{\sin 50\pi t}{\pi t}$
(d) $125\frac{\sin 31.25\pi t}{\pi t}$

Problem 7.7
Yes, it is possible, and there are two choices for $T$. We can choose $T = \frac{\pi}{3c}$, so that $h[n] = \delta[n]$, or $T = \frac{\pi}{5c}$, so that $h[n] = \frac{\sin(\Omega c n)}{\pi n}$, where $\Omega_c$ is any number in the range $\frac{3\pi}{5} < \Omega_c < \pi$.

Problem 7.8
(a) $H(e^{j\Omega}) = \frac{1}{1 - e^{-j\pi T} + 3e^{-j\pi T}}$.
(b) The input signal $x(t)$ must be bandlimited, and the Nyquist sampling condition must hold.
(c) $H_c(j\omega) = \begin{cases} \frac{1}{1 - e^{-j\omega T} + 3e^{-j\omega T}}, & |\omega| \leq \pi/T \\ 0, & |\omega| > \pi/T \end{cases}$
(d) \[ y(t) - \frac{1}{2}y(t - T) + 3y(t - 2T) = x(t). \]

**Problem 7.9**

\( x_c(t) \) needs to be bandlimited to 24000\( \pi \) rad/sec, or 12 kHz.

**Problem 7.10**

(a) \( H_c(j\omega) = \frac{1}{(j\omega)^2 + 2(j\omega) - 1}. \)

(b) \( H_d(e^{j\Omega}) = H_c(j\omega)|_{\omega = \Omega/T} \) in the range |\( \Omega \)| < \( \pi \). So, \( H_d(e^{j\Omega}) = H_c(j\frac{\Omega}{T}) \) for \(-\pi < \Omega < \pi\) and is periodic with period 2\( \pi \).

**Problem 7.11**

(a) True
(b) True
(c) True
(d) False