MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.003: Signals and Systems — Spring 2004

Tutorial 8 Solutions

Tuesday, April 6, 2004

Problem 8.1

(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 8.2

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 Ω_c is any number in the range $\frac{3\pi}{5} < \Omega_c < \pi$.

Problem 8.3

(a) $H(e^{j\Omega}) = \frac{1}{1-\frac{1}{2}e^{-j\Omega}+3e^{-2j\Omega}}$.

(b) The input signal $x(t)$ must be bandlimited, and the Nyquist sampling condition must hold.

(c) $H_c(j\omega) = \begin{cases} \frac{1}{1-\frac{1}{2}e^{-j\omega T}+3e^{-2j\omega T}}, & |\omega| \le \pi/T \\ 0, & |\omega| > \pi/T \end{cases}$

(d) $y(t) - \frac{1}{2}y(t-T) + 3y(t-2T) = x(t)$.

Problem 8.4

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

Problem 8.5

(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, $H_d(e^{j\Omega}) = H_c\left(j\frac{\Omega}{T}\right)$ for $-\pi < \Omega < \pi$ and is periodic with period 2π.

Problem 8.6

(a) True

(b) True

(c) True

(d) False