Problem 8.1

$$f_s = 1000\frac{samples}{sec}$$

$$x(t) = 5 + 4\cos(200\pi t) + 3\cos\left(500\pi t + \frac{\pi}{4}\right)$$

$$x(t) = 5 + 2e^{j200\pi t} + 2e^{-j200\pi t} + \frac{3}{2}e^{j500\pi t}e^{j\frac{\pi}{4}} + \frac{3}{2}e^{-j500\pi t}e^{-j\frac{\pi}{4}}$$

$$X(z) = 5 + 2z^{200\pi} + 2z^{-200\pi} + \frac{3}{2}z^{500\pi}\text{C}-\therefore\ \rho * ?\ \$\%\text{^}$$

$$H(z) = (1 - z^{-2})$$

Multiply X(z) by H(z) to find Y(z).
Inverse z transform to find y(t)

Problem 8.2

1. $y[n]$
2. $Y(z)$
3. $y[n]$
4.

Problem 8.3

a.

$$H(z) = \frac{1}{4}[1 - z^{-4}]$$

b.

$$\frac{1}{4}\left[1 - e^{-j4\omega}\right]$$

c.

$$y(t) = \cos\left(6000\pi t - \frac{\pi}{4}\right)$$

Problem 8.4

a.

$$H(z) = 1 + 2x^{-2} + z^{-4}$$

$$h(n) = \delta[n] + 2\delta[n-2] + \delta[n-4]$$

b.

$$h(z) = 1 + z^{-1} + z^{-2} + z^{-3} + z^{-4}$$

$$H\left(e^{j\omega}\right) = 1 + e^{-j\omega} + e^{-j2\omega} + e^{-j3\omega} + e^{-j4\omega}$$

$$y[n] = x[n] + x[n-1] + x[n-2] + x[n-3] + x[n-4]$$

c.

$$H(z) = z^{-3} + 0.5z^{-1} + 0.5z^{-5}$$

$$y[n] = x[n-5] + 0.5x[n-1] + 0.5x[n-5]$$

d.

$$H\left(e^{j\omega}\right) = 1 - 2e^{-j2\omega} + e^{-j4\omega} + e^{-j7\omega}$$

$$h[n] = \delta[n] - 2\delta[n-2] + \delta[n-4] + \delta[n-7]$$

$$y[n] = x[n] - 2x[n-2] + x[n-4] + x[n-7]$$

Problem 8.5

a.

$$f_s = 1000\frac{samples}{sec}$$

$$x[n] = 1 + 3\cos\left(3000\pi * \frac{n}{1000} - \frac{\pi}{8}\right) + 2(\cos\left(8000\pi * \frac{n}{1000} + \frac{\pi}{3}\right)$$

$$x[n] = 1 + 3\cos\left(3\pi n - \frac{\pi}{8}\right) + 2\cos\left(8\pi n + \frac{\pi}{3}\right)$$

$$= 1 + \frac{3}{2}e^{j3\pi n - \frac{\pi}{8}} + \frac{3}{2}e^{-j3\pi n - \frac{\pi}{8}} + e^{j8\pi n + \frac{\pi}{3}} + e^{-j8\pi n + \frac{\pi}{3}}$$

$$X(z) =$$

b.

$$f_s = 5000\frac{samples}{sec}$$

$$x[n] = 1 + 3\cos\left(3000\pi * \frac{n}{5000} - \frac{\pi}{8}\right) + 2(\cos\left(8000\pi * \frac{n}{5000} + \frac{\pi}{3}\right)$$

Problem 8.6

a.

$$h[n] = \delta[n] + \delta[n]z^{-1} + \delta[n]z^{-2} + \delta[n]z^{-3} + \delta[n]z^{-4} + \delta[n]z^{-5}$$

b.

$$H(z) = \frac{1 - z^{-6}}{1 - z^{-1}}$$

$$H(z) = 1 + z^{-1} + z^{-2} + z^{-3} + z^{-4} + z^{-5}$$

$$\sum_{k=0}^{5} x[n-k] \rightarrow converges\ to\ \frac{1 - z^{-6}}{1 - z^{-1}}$$

c.

Problem 8.7

a.

b. $H\left(e^{j\omega}\right) = \frac{\sin(3\omega)}{\sin\left(\frac{\omega}{2}\right)}e^{-j\frac{5\omega}{2}}$

c.

d. $x[n] = 2 + 8\cos(\omega_0 n), y[n] = c$

Problem 8.8

$$H(z) = z^{-1}(1 - z^{-2})(1 - jz$$

a.

$$H(z) = z^{-1} - z^{-2} + z^{-3} - z^{-4}$$

$$Y(z) = (z^{-1} - z^{-2} + z^{-3} - z^{-4})X(z)$$

$$y[n] = x[n-1] - x[n-2] + x[n-3] - x[n-4]$$

b.

$$y[n] = \delta[n-1] - \delta[n-2] + \delta[n-3] - \delta[n-4]$$

c.

$$x[n] = \delta[n] - 3\delta[n-1] + 3\delta[n-3] - \delta[n-4]$$

$$y[n] = \delta[n-1] - 3\delta[n-2] + 3\delta[n-3] - \delta[n-4] + \delta[n-5] + \delta[n-6] - \delta[n-7] - \delta[n-8]$$

d.

$$x[n] = e^{j\omega n}$$

When $\omega = 0, y[n] = 1 - 1 + 1 - 1 = 0$