Digital Communications
Homework #2
Due 9/7/2007

1. Drill problem 5.5 from the text.

2. Drill problem 5.6 from the text.

3. Consider the signal $x(t) = rect(2500t)\cos(20000\pi t)$. What is the Nyquist rate for this signal? If the signal is passed through a filter whose impulse response is defined as $h(t) = \text{sinc}(1000t)\cos(20000\pi t)$ what is the Nyquist rate? Consider the question using the *baseband sampling theorem* as well as the *bandpass sampling theorem.*

4. Consider a signal whose power spectral density is

$$S_x(f) = \text{sinc}^2\left(\frac{f+100000}{5000}\right) + \text{sinc}^2\left(\frac{f-100000}{5000}\right)$$

(a) What is the Nyquist rate? (b) Let us define the non-neglible frequency components as those within 40dB of the peak of the PSD. Using the 40dB bandwidth as an approximation of the absolute bandwidth, what is the Nyquist rate? (c) If the signal is passed through a filter whose impulse response is $h(t) = \text{sinc}(1000t)\cos(200000\pi t)$ what is the Nyquist rate of the output again using the 40dB bandwidth as the absolute bandwidth?

5. Problem 5.12 from the text.

6. Consider the signal

$$x(t) = \cos(2\pi f_o t)$$

The signal is sampled at a rate f_s and passed through an ideal (brick wall) reconstruction filter with bandwidth $B = 1.25\, f_o$.

(a) Find the output of the reconstruction filter *y(t)* if $f_s = 3f_o$.
(b) Find the output of the reconstruction filter *y(t)* if $f_s = 2.25f_o$.
(c) Find the output of the reconstruction filter *y(t)* if $f_s = 1.5f_o$.