

ECE 457
HOMEWORK #5
Due February 18, 2005

- Read Chapter 3.2.1 and 3.2.3
 - Office Hours: W 11:30-1:00 pm., Th 9:30-11:00 a.m., 2210EB.
1. [20] An AM modulated signal is given by $x_c(t) = (20 + 10\cos(6000\pi t))\cos(2\pi f_c t)$, where $f_c = 10$ kHz.
 - a) What's the power transmitted for this AM signal? What's the bandwidth? Sketch the amplitude spectrum.
 - b) If the same message signal is transmitted using DSB, what's the bandwidth and the power transmitted? Sketch the amplitude spectrum.
 - c) If the same message signal is transmitted using USB, what's the bandwidth and the power transmitted? Sketch the amplitude spectrum.
 2. [20] 3.31 from Ziemer and Tranter. Plot the resulting FM modulated signal using MATLAB.
 3. [20] 3.34 from Ziemer and Tranter.
 4. [20] Consider a narrowband FM signal approximately defined by $x_c(t) = A_c \cos(2\pi f_c t) - \beta A_c \sin(2\pi f_c t) \sin(2\pi f_m t)$
 - a) Determine the envelope of this modulated signal. What's the ratio of the maximum to the minimum value of this envelope? Plot this ratio versus β assuming that β is between 0 and 0.3. Use MATLAB.
 - b) Determine the average power of the narrowband FM signal. Express this average power as a percentage of the average power of the unmodulated carrier wave. Plot this result versus β assuming β is between 0 and 0.3 Use MATLAB.
 - c) Sketch the amplitude and phase spectra for this narrowband signal in terms of the given parameters.
 5. [20] 3.28 from Ziemer and Tranter. Does this signal remind you of a linear modulation technique? Why or why not?
Hint: First write the given signal as $a(t)\cos(2\pi f_c t) + b(t)\sin(2\pi f_c t)$, then find the envelope as $\sqrt{a^2(t) + b^2(t)}$ and the phase as $\tan^{-1} \frac{b(t)}{a(t)}$.