ELEC 3400 Communication Systems
Fall 2004

Homework 4
Assigned on Wed. 09/22; Class discussion on Mon. 09/27

Problem 1:
An SSB modulated signal is generated by modulating a 1000-Hz carrier by the signal \( m(t) = \cos(1000\pi t) - 2\sin(1000\pi t) \). The amplitude of the carrier \( A_c = 100 \).
(a) Determine the signal \( \hat{m}(t) \);
(b) Determine the (time domain) expression for the upper sideband modulated signal.

Problem 2:
Problem 3.15 in the textbook.

Problem 3:
A message signal \( m(t) \) is scrambled through the following block diagram in Figure 1 (a) where \( \omega_c > \omega_M \). The scrambled signal spectrum \( x(t) \) is given in Figure 1 (b). If \( x(t) \) is the input of Figure 1(a), sketch the spectra of the signals at the stages A-C and the output (mark the important frequencies in your plots).

![Figure 1: (a) scrambling/descrambling block diagram; (b) spectrum of scrambled signal \( x(t) \)](image)

Problem 4:
The message signal \( m(t) \) whose Fourier transform \( M(f) \) is shown in Figure 2 is to be transmitted from point A to point B. It is known that the signal is normalized, meaning that \(-1 \leq m(t) \leq 1\). Suppose the carrier frequency is \( f_c \), the amplitude is \( A_c \), and the carrier signal is \( A_c \cos(2\pi f_c t) \). Find the time domain expressions of the following modulation schemes, and sketch the spectra (mark necessary frequencies and amplitudes): (a) DSB; (b) upper sideband SSB; (c) AM with modulation index \( a = 0.8 \).