EECS 562
Homework #2

1. A message signal is m(t)=10cos(2πt) volts and the carrier wave is c(t) = 50cos(100πt) volts, the percent modulation (sometimes called modulation index or modulation factor) is 90%
   a. Plot the RF signal in the time domain to scale.
   b. What is the total RF transmitted power assume a 100 ohm load.
   c. What is the power in the carrier wave assume a 100 ohm load.
   d. What is the RF bandwidth?
   e. Plot the power spectral density of the RF signal.

2. For a sequence of information bits b_i {0,1,1,0,0,1}; i=1..6, the message signal is formed as

$$m(t) = \sum_{i=1}^{6} b_i rect[t - i - 0.5)]$$

   a. Plot m(t)
   b. For 50% AM percent modulation plot the RF time-domain signal (use f_c=10Hz)
   c. For 100% AM percent modulation plot the RF time-domain signal (use f_c=10Hz)

3. Consider a sequence of information bits b_i {....0,1,0,1,0,1,0,1....}, That is, alternating 0's and 1's.

   A baseband analog message signal is formed as $m(t) = \sum_{i=-\infty}^{\infty} c_i rect[t - i - 0.5)]$

   where c_i=-1 if b_i = 0 and c_i=+1 if b_i = 1
   a) Plot $m(t)$.
   b) What is the DC (or average value) of m(t)?
   c) AM modulation is used to transmit $m(t)$. Plot the RF amplitude spectrum for 100% AM percent modulation (use f_c=100Hz) [Hint: find the Fourier Series of $m(t)$ then apply the modulation theorem and add in the carrier term.]

4. 3.25

5. 3.28

6. Let s(t) be an DSB-LC (AM) signal. The unmodulated transmitted power is 5 KW. The message signal is m(t) = cos(2πf_mt). The modulated transmitted power is 7 KW.
   a. Find the corresponding A_c and k_a in equation 3.2.
   b. What is the modulation factor?
   c. What is the power efficiency?
   d. What is the RF bandwidth?

7. Given a baseband bandwidth of 90kHz for signals $x_1(t)$, $x_2(t)$, $x_3(t)$.... $x_N(t)$, i.e., B_i=90kHz for i=1…N. These signals are modulated using DSB-SC modulation. The modulated DSB-SC signals are frequency division multiplexed using a shared assigned RF spectrum of 15MHz.
   a. Assuming no guard band find N.
   b. Assuming a 20 KHz guard band find N.

8. An DSB-LC RF signal is plotted in the time domain below. What is the modulation index (modulation factor)?