25.108 Intro to Engineering II for ECE
Extra Credit Matlab Problem

Background: In this problem you will design an AM software radio and this time make it so you can modulate and demodulate a real signal. The problem is fairly open ended which is part of the challenge. You will have to look up what each of these DSP functions do. Here is the outline of what I want you to do

1) Load the standard audio file "handel"
2) Listen to it using soundsc and Fs=8192
3) Design a low pass filter with BW=2000 Hz and cutoff at 2500 Hz, filter the signal and listen again, 40 dB of attenuation is fine for this application.
4) You need to up-sample the function. Resample the function using the following commands Newout=resample(yoursignal, 5,1). This will up-sample the rate from 8192 to 5 times that which is 40960. That means instead of 8192 points/sec there will be 40960, and the sampling rate is now 40960 Hz.
5) Listen to the new signal but with a new sampling rate, should sound the same.
6) Create a time axis equal to the length of the new signal with a delta T of 1/40960. Make sure that dimensions of matrices match.
7) Create a carrier at a frequency of 15000 Hz (cos(2*pi*time*15000)
8) Create large carrier AM (1+yoursignal).*carrier
9) Look at using your spectrum analyzer, both your AM large carrier signal, and your modulating signal "yoursignal": you may have to do some transposing to get the matrix dimensions to match. You will see the upper and lower sidebands and the carrier signal.
10) Now detect the signal using coherent detection (e.g. multiply by the carrier again)
11) Design a new filter with the same bandwidth as before (2000,2500), but now with a sampling frequency of 40960 and filter your signal.
12) Now do the same non-coherent demodulation (that means using an ideal diode out=in.*(in>0). Do this and refilter and listen to it.
13) Listen to both, and look at it in the spectral domain. Congrats you have built a software AM radio.

What to hand in. Repeat what you did for the AM laboratory only with the more complicated waveforms.