

ECE 457
HOMEWORK #4
Due February 11, 2005

- Read Chapter 3.1.3 and 3.1.4
- Office Hours: W 11:30-1:00 pm., Th 9:30-11:00 a.m., 2210EB.

1. [20] 3.14 from Ziemer and Tranter. This is the derivation of the USB signal.
2. [20] 3.16 from Ziemer and Tranter.
3. [25] The message signal $m(t) = \cos(20\pi t)$ is modulated by the carrier $10 \cos(400\pi t)$ using LSB-SSB.
 - a) Plot the modulated signal using MATLAB.
 - b) Sketch the amplitude and phase spectra for the modulated signal.
 - c) What are the bandwidth and the power content of the modulated signal?
 - d) Write a MATLAB program that will give you the output of the demodulator using carrier insertion. Plot three outputs for $K=1, 3,$ and 10 . Compare the results to the actual message signal.

Hint:

```
>>%Define  $A_c, A_m, \omega_c, \omega_m, t, K$  ;  
>>xc=0.5*Ac*Am*cos (wm*t) .*cos (wc*t)+0.5*Ac*Am*sin (wm*t) .*sin (wc*t)  
);  
>>%demodulated signal using carrier reinsertion;  
>>d=sqrt(((0.5*Ac*Am*cos (wm*t)) +K) .^2+(0.5*Ac*Am*sin (wm*t)) .^2);
```

4. [20] An USB signal is generated by using the phase-shift modulation method. If the input to this system is $\hat{m}(t)$ instead of $m(t)$, what will be the output? Is this signal still an SSB signal with bandwidth equal to that of $m(t)$? Can this signal be demodulated to get back the message $m(t)$? If so, how?
5. [15] A message signal $m(t) = B \sin c(Bt)$ with $B = 1000$ is modulated by carrier wave $\cos(20,000\pi t)$.
 - a. Sketch the spectra of the message and the DSB modulated message.
 - b. Find the USB spectrum.
 - c. Find the USB signal in the time domain.