

ECE 457
HOMEWORK #3
Due February 4, 2005

- Read Chapter 3.1.2
- Office Hours: M 11:30-1:00 pm., Th 9:30-11:00 a.m., 2210EB.

1. [25] The signal $m(t) = 3\cos(200\pi t) + \sin(600\pi t)$ is modulated using the carrier $\cos(20,000\pi t)$. The modulation index is $a=0.85$.
 - a) Find the normalized message, $m_n(t)$.
 - b) Plot the AM modulated signal using MATLAB. Include your code and the plot.
 - c) Determine the efficiency of this AM system.
 - d) Now, let $0 \leq a \leq 2$, plot efficiency, E , versus the modulation index. What is the maximum power efficiency one can achieve so that the message signal can be recovered using envelope detection?

You can use the following MATLAB code to do this part:

```
>> t=[0:.001:0.1];
>> m=3*cos(2*pi*100*t)+sin(6*pi*100*t);
>> mmin=min(m); %minimum value of m;
>> mn=_____ %fill in the blanks;
>>a=[0:.01:2];
>>L=length(a);
>>for k=1:L;
>>xc=(1+a(k)*mn).*cos(2*pi*fc*t); %put in the value for fc;
>>E(k)=_____;%put in the formula for
>>Efficiency;
>> end
>>plot(a,E);%include titles and labels;
```

2. [20] The output signal from an AM modulator is $x_c(t) = 5\cos(1800\pi t) + 20\cos(2000\pi t) + 5\cos(2200\pi t)$
 - a) Determine the message signal and the carrier.
 - b) Determine the modulation index.
 - c) Determine the ratio of the power in the sidebands to the power in the carrier, i.e. efficiency.
3. [15] 3.4 from Ziemer and Tranter.
4. [20] 3.12 from Ziemer and Tranter.
5. [20] 3.6 from Ziemer and Tranter. Notice that the efficiency values are higher than the case when we have symmetric signals.