ECE 300
Signals and Systems
Homework 2

Due Date: Friday March 17 at 2:30 PM

Reading: K & H, pp. 25-47 (skip the discrete-time stuff).

Problems

1 For each of the following signals, determine E_∞ and P_∞ into 1 Ω. Classify each of the following signals as energy or power signals (or neither).

a. $v(t) = 4$
b. $v(t) = 3\cos(2\pi 10t + 15°)$
c. $i(t) = 4\exp(-2|t|)$
d. $x(t) = 4rect\left(\frac{t-2}{3}\right)$

2 For each of the following signals, determine if the signal is periodic and, if so, the fundamental period.

a. $x(t) = \sin(2t) + \cos(3t + 30^o)$
b. $x(t) = \cos(2t) + \cos(\pi t)$
c. $x(t) = e^{-t}\cos(t)$
d. $x(t) = 2e^{j2t} + 3e^{j(3t+2)}$

3. (Matlab problem) Read, from the class website, *Simulating Waveforms in Matlab,* and then, using Matlab, plot each signal from Problem 2 for three *fundamental periods* if the signal is periodic, or three times the longest period in the signal if the signal is not periodic. Be sure there are at least 50 samples per period for each waveform and your graphs are neatly labeled. **Notes:** (1) Matlab works in radians, so all angles must be converted to radians, (2) use **exp** in Matlab to get an exponential, (3) **j** is Matlab's way of indicating the square root of -1, and if you want $x(t) = e^{j2t}$ you should type something like ***x = exp(j*2*t)***, and (4) if the waveform is complex, plot the real and imaginary parts separately. The Matlab commands **real** and **imag** are very useful for this. Turn in your plots.

4. (Matlab problem)

a. Using Matlab, plot the signal $x(t) = 2\cos(3t)$ for t between -5 and 5. Be sure there are at least 50 samples per period. Turn in your plot.
b. Assume we want to construct $y(t)$, where

$$y(t) = \begin{cases} 2x(t) & 1 < t < 3 \\ 0 & else \end{cases}$$

Show that we can construct $y(t)$ by multiplying $x(t)$ by an appropriate **rect** function, and do this in Matlab. Turn in your plot. **Note**: You will need to use the **.*** multiplication, since both **x** and the ***rect*** are vectors and you want element by element multiplication. Use the **unit_rect.m** function from last week's homework.

5. K & H, Problem 1.24, 1.25 and 1.26 parts **a**, **c**, **d**, **e**, **g**, and **j**. (do them all together). For **e**, look at the case when $x(t)$ is large, and then when $x(t)$ is assumed to be sufficiently small that you can use a small angle approximation. In addition, answer the questions for parts **k-m** below:

k $y(t) = x(t - t_0) \quad t_0 > 0$

l $y(t) = x\left(\frac{t}{3}\right) + 2$

m $y(t) = e^t \int_{-\infty}^{t} e^{-\lambda} x(\lambda - c) d\lambda$ **,** $c > 0$

You need to justify your answers. Fill in the following table (or a similar table) to summarize your results (put a Y or N for each question).

Part	Causal?	Memoryless?	Linear?	Time Invariant?
a				
c				
d				
e- $x(t)$ large				
e- $x(t)$ small				
g				
j				
k				
l				
m				

For part **c**, you should show $y(t) = y(t_0)e^{\int_{t_0}^{t} x(\lambda)d\lambda}$ in order to determine whether the system is or is not causal and has memory or is memoryless.

For part **d** you should show $y(t) = y(t_0)e^{3(t-t_0)} + \int_{t_0}^{t} 2e^{3(t-\lambda)}x(\lambda)d\lambda$ in order to determine the system is or is not causal and has memory or is memoryless.

For part **j** you should show $y(t) = y(t_0)e^{\frac{3}{2}(t^2-t_0^2)} + \int_{t_0}^{t} 2e^{\frac{3}{2}(t^2-\lambda^2)}x(\lambda)d\lambda$ in order to determine the system is or is not causal and has memory or is memoryless.

If you have trouble with these, read pages 26-28 on integrating factors, and pages 58 and 59 on first order cases. However, you must show your work here and not just use the answers in the book.