EE 204 Signals and Systems Laboratory 6

I. Preparation

1) A discrete time signal x[n] is defined as below

$$x[n] = e^{-|n/10|} sin(\frac{2\pi n}{4})$$

Inspect the following matlab code which computes the energy and power of the signal.

$n = -100 : 100;$
$xn = exp(-abs(n/10)). * sin(2 * pi * n/4);$
$stem(n, xn);$
$xnSq = xn. * xn;$
$Ex = sum(xnSq);$
$disp(['Energy\ of\ the\ signal\ is:\ ', num2str(Ex)]);$
$Px = Ex/length(n);$
$disp(['Power\ of\ the\ signal\ is:\ ', num2str(Px)]);$

Play with the n range and see the energy and power values. For a aperiodic signal energy value is a constant. In addition, power equals 0 as n range goes to infinity.

2) Now generate a periodic signal using the above x[n]. Lets say that the period equals N. Modify the above matlab code into a matlab function. Using the matlab function generate a periodic signal with period N. Compute the energy of the periodic signal. Compute the power of the periodic signal.

Note: Compute the energy of the periodic signal in one period and divide this value to the period to find the power of the periodic signal. As you will notice the power of a periodic signal is not zero. However the power of that aperiodic signal equals zero in our example.

3) A continuous time signal x(t) is defined as below:

$$x(t) = 5e^{-|t|/2} cos(2\pi t)$$

Inspect the following matlab code that computes the energy and power of the signal.

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t=-10:0.01:10;
gt=5*exp(-abs(t/2)).*cos(2*pi*t);
plot(t,gt);
gtSq=gt.*gt;
Ex=trapz(t,gtSq);
Px=Ex/(max(t)-min(t));; % 10-(-10)=20 is the length of the time interval over which integration is taken
disp(['The energy of the signal is: ',num2str(Ex)]);
disp(['The power of the signal is: ',num2str(Px)]);
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4) Now generate a periodic CT signal using x(t) in part 3. Determine the period value T by yourself. Compute the power and energy of the periodic signal.

5) Determine the periods of the following signals by hand computation.
a) $x(t) = 10cos(100\pi t)$
b) $y(t) = 40cos(60\pi t) + 20sin(40\pi t)$

II. Experimental Work

1) Draw the signals in part 5, then do the followings

a) Compute the Energy and power of the signals in one period.

b) Sum the signals in preparation 5a, 5b. Plot it. Can you determine the periodicity using graph. If yes, determine the period. Compute energy and power of the summed signal. Compare the values with that of the ones in Experimental work 1a.

2) Sketch the following DT functions and compute their Energy and power. Using the sketch first determine whether that are periodic or not. Then compute energy and power.

a) $g[n] = 2(0.9)^n sin(\frac{2\pi n}{4})$

b) $g[n] = cos(\frac{2\pi(n+1)}{12})u[n+1] - cos(\frac{2\pi n}{12})u[n]$

c) $g[n] = \frac{3n+6}{10} e^{-2n}$

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