

ECE 438
Homework 1, due in class Friday, 8/27/2004.

Problem 1. For each discrete-time (DT) signal below, do the following.

(i) Sketch $x(n)$ by hand, i.e. do not use Matlab. Carefully label the plots.

(ii) Calculate its energy, i.e. $\sum_{n=-\infty}^{+\infty} |x(n)|^2$. Do not use Matlab.

(iii) Calculate the convolution of the signal with itself. In other words, evaluate the following:

$$x * x(n) = \sum_{k=-\infty}^{+\infty} x(k)x(n-k). \text{ Do not use Matlab.}$$

(iv) Find the smallest number L which satisfies the following inequality for every integer n :
 $|x(n)| \leq L$.

(v) Find the smallest number M which satisfies the following inequality for every integer n :
 $|x * x(n)| \leq M$.

a. $x(n) = 4^{-|n|}$.

b. $x(n) = n \cdot [u(n-1) - u(n-6)]$.

Here, as usual, $u(n)$ is the DT unit step.

Hints.

1. Recall that the expression $\sum_{k=-\infty}^{+\infty} y(k)$ means: $\lim_{m \rightarrow -\infty, p \rightarrow +\infty} \left(\sum_{k=m}^p y(k) \right)$.

2. In order to compute the convolution for the first signal, it could be helpful to consider two cases: $n < 0$ and $n \geq 0$, and in each case, to sketch both $x(k)$ and $x(n-k)$ as functions of k .

3. The numbers L and M in parts (iv) and (v) are the global maxima of the signals $|x(n)|$ and $|x * x(n)|$, respectively.