1. Cosine and sine transforms

The Fourier transforms of even and odd functions are very important. The reason is that they are computationally simpler than the Fourier transform. Let

* 1. Plot x(t) and y(t), and determine whether they are even or odd.
  2. Show that the Fourier transform of x(t) is found from

Which is a real function of Ω, thus its computational importance. Show that X(Ω) is also even as a function of Ω.

* 1. Find X(Ω) from the above equation (called the cosine transform).
  2. Show that the Fourier transform of y(t) is found from

1. Sampling output of nonlinear system

The input-output relation of a nonlinear system is

is the input and y(t) is the output

1. The signal x(t) is band limited with a maximum frequency rad/sec. Determine if y(t) is also band limited, and if so, what is its maximum frequency ?
2. Suppose that the signal y(t) is low-pass filtered. The magnitude of the low-pass filter is unity and the cut-off frequency is Determine the value of the sampling period according to the given information.
3. Is there a different value for that would satisfy the Nyquist sampling rate condition for both x(t) and y(t) and that is larger than the one obtained above? Explain.
4. Causal systems and real-time processing

Systems that operate under real-time conditions need to be causal-that is, they can only process present and past inputs. When no real-time processing is needed the system can be noncausal.

1. Consider the case of averaging an input signal x[n] under real-time conditions. Suppose you are given two different filters.

Which one of these would you use and why?

1. If you are given a tape with the data, which of the two filters would you use? Why? Would you use either? Explain.
2. Z- transform properties and inverse transform

Sometimes the partial fraction expansion is not needed in finding the inverse Z-transform-instead the properties of the transform can be used. Consider the function.

1. Determine whether F(z) is a proper rational function as a function of z and of .
2. Verify that F(z) can be written as

Find the invers Z-transform f[n] using the above expression.