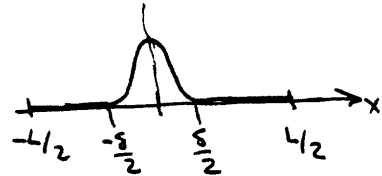


Due 10/4/02

Problem Set 3

- 1) Compute the amplitude and phase spectra for the examples given in the class notes [square wave, sawtooth, "rectified" sine wave, delta function]. Express the answers as formulae and give asymptotic results for large n in terms of a single power of n (e.g. n^{-2}).
- 2) Consider the "cosine bell" function

$$f(x) = \begin{cases} 1 + \cos 2\pi x / \delta & -\frac{\delta}{2} \leq x \leq \frac{\delta}{2} \\ 0 & \text{elsewhere} \end{cases}$$



Assume periodicity with "unit cell" of length L .

- a) Derive the Fourier coefficients a_n and b_n .
- b) Write formulae for a_n and b_n for the special case $\delta = L$.
- c) For the special case $\delta = L/2$, derive a simple form for the coefficients. Compare this form with the form for the similarly shaped "rectified" sine wave. How are the spectra different? Why?
- d) Compute and plot the amplitude and phase spectra for $\delta = L/10$ and $n \leq 50$. Comment on the shape of the spectrum in terms of that for a delta function.
- e) Using your results from d), plot the function expanded over the ranges:

$$0 \leq n \leq 20$$

$$0 \leq n \leq 10$$

$$11 \leq n \leq 20$$

Comment on the physical reality of the features in each plot.