Homework 9

Date Assigned: Monday, October 11, 2004
Date Due: Wednesday, October 13, 2004

Reading: Please continue to study Chapter 3 in the Lathi text on Fourier series.

1. Please experiment with the Simulink demonstration of Fourier series that we used in class. You can access the demonstration from the course home page under `Class Notes and Demonstrations`.

   You do not have to submit anything for this part.

2. In the Simulink demonstration `fsgen.mdl`, the three individual sine waves that are added together are

$$f_1(t) = \sin(2\pi t)$$
$$f_3(t) = \sin(2\pi 3t)$$
$$f_5(t) = \sin(2\pi 5t)$$

   Compute the "inner products" of pairs of these sine waves over the interval $[0, 1]$. That is, compute the following integrals:

$$\int_0^1 f_1(t)f_1(t)\,dt, \quad \int_0^1 f_1(t)f_3(t)\,dt, \quad \int_0^1 f_1(t)f_5(t)\,dt$$

$$\int_0^1 f_3(t)f_3(t)\,dt, \quad \int_0^1 f_3(t)f_5(t)\,dt, \quad \int_0^1 f_5(t)f_5(t)\,dt$$

   Here are some useful identities:

$$\sin^2 a = \frac{1}{2}\left[1 - \cos(2a)\right], \quad \sin a \sin b = \frac{1}{2}\left[\cos(a-b) - \cos(a+b)\right]$$

   You may find it useful to sketch the integrand in each case.

3. What does it mean geometrically when two *vectors* have an inner (or dot) product of zero? Draw a picture of this situation in two dimensions.