ECEn 560
Electromagnetic Wave Theory

Homework #3
Due Jan. 21, 2010 in class

1. Fill in the blanks: A Green's function is the unique solution to a _____, which consists of a _____, a _____, and a _____ source. A Green's function is the spatial analog of the _____ of a linear system. The solution to a boundary value problem for an arbitrary source distribution can be obtained by _____ the _____ with the _____. In electromagnetic theory, this mathematical expression is called a _____.

2. (a) The 1D scalar Green's function is defined by

$$\left(\frac{d^2}{dx^2} + k^2\right) g(x, x') = -\delta(x - x')$$

with an outgoing radiation boundary condition at $\pm\infty$. Show that the Green's function is given by

$$g(x, x') = \frac{i}{2k} e^{ik|x-x'|}$$

(b) Is $g(x, x') = ie^{ik|x-x'|}/(2k) + e^{ikx}$ a Green's function for this problem? Why or why not?

3. Use MATLAB and the 2D scalar free space Green's function to create two-dimensional image plots of the magnitude of the field radiated by (a) a time-harmonic line source at the origin and (b) two line sources, one at $x = -\lambda/4$, $y = 0$ and the other at $x = \lambda/4$, $y = 0$. Assume the currents on the two line sources are in phase and equal in amplitude.

4. Go through and understand the steps in the derivation of the 3D scalar free space Green's function.