Projects: Please email me an outline for your project by April 1. (More instructions are available on the course web site.)

1. For this problem, let’s assume that $r' = 0$. Confirm that $e^{ikr}/4\pi r$ is the Green’s function of the operator $-(\nabla^2 + k^2)$. In other words, demonstrate that

$$-(\nabla^2 + k^2) \frac{e^{ikr}}{4\pi r} = \delta(r).$$

Do this by showing (a) that the LHS is equal to zero for $r \neq 0$ and (b) that the integral of the LHS over a volume that includes $r = 0$ is 1. Work in spherical coordinates.

2. Starting from Maxwell’s equations with sources $\rho(r, t)$ and $J(r, t)$ in vacuum, show that

$$-\nabla^2 E = -\frac{1}{\epsilon_0} \nabla \rho - \mu_0 \frac{\partial J}{\partial t}$$

$$-\nabla^2 B = \mu_0 \nabla \times J$$

These are similar expressions to Eq. 10.16 in your text, except written in terms of the fields themselves and with a RHS that is somewhat more complicated. Given that the Green’s function of $-\nabla^2$ is $\delta(t - r/c)/4\pi r$ one could integrate the product of the Green’s function with the RHS above to solve directly for the fields. Performing the integral over time yields the Jefimenko Equations (Eqs. 10.29 and 10.31) in your text. (For this problem, just derive Eqs. 2 and 3 above.)

3. Griffiths Problem 10.6
4. Griffiths Problem 10.10
5. Griffiths Problem 11.3
6. Griffiths Problem 11.6
7. Griffiths Problem 11.7
8. Griffiths Problem 11.22