PHYS 334 **Electromagnetic Theory II** **Spring 2024**

Homework #7 — due Friday, March 22

Numbers refer to the problems in Griffiths

From Friday, March 8:

1. 10.5
2. 10.6
3. 10.7

From Monday, March 18:

4. ~~10.10~~ **Problem E**

   Let's derive the Green's function for the d'Alembertian operator. We will assume the answer, namely

   $$f(\mathbf{r}, \mathbf{r}', t, t') = \frac{1}{4\pi\mathscr{r}}\delta(t - \mathscr{r}/c)$$

   and then show it is the solution to the equation $\Box^2 f(\mathbf{r}, \mathbf{r}', t, t') = -\delta^{(3)}(\boldsymbol{\mathscr{r}})\delta(t - t')$.

   To do this, evaluate $\nabla^2 f$, using the product rule $\nabla^2(gh) = g\nabla^2 h + 2\nabla g \cdot \nabla h + h\nabla^2 g$, with $g = \frac{1}{4\pi\mathscr{r}}$ and $h = \delta(t - \mathscr{r}/c)$.

   (a) Show that $h\nabla^2 g = -\delta^{(3)}(\boldsymbol{\mathscr{r}})\delta(t - t')$. Note that in the term $\delta^{(3)}(\boldsymbol{\mathscr{r}})\delta(t - \mathscr{r}/c)$ we can set $\mathscr{r} = 0$ in the time delta function because it's multiplied by $\delta^{(3)}(\boldsymbol{\mathscr{r}})$.

   (b) Evaluate the other two terms. For derivatives of the δ function you can take, e.g., $\nabla\delta(t - \mathscr{r}/c) = \delta'(t - \mathscr{r}/c)\nabla(-\mathscr{r}/c)$. Simplify as much as possible.

   (c) Show that you end up getting the Green's function equation above.

5. 10.12

From Wednesday, March 20:

6. 10.14
7. 10.25