PHYS 333

Information for Final Exam

Time: Monday, December 15, 7:30–10:30 p.m.

Place: Olin 264

Last Minute Office Hours: I will be intermittently available throughout the day on Monday 12/15. I will have some responsibilities administering the PHYS 211 exam, but I will be able to make time for questions on E&M.

This will be a closed book examination. I will provide you with copies of the inside covers of your text, photocopies of the figures representing differential volume elements in cylindrical and spherical coordinates, and an equation sheet. The exam will be about twice as long as one of the exams I have already given. Some of the of the exam will cover material since Exam III, and at least half will be on the material covered previously. The "new" material for which you are responsible is in Griffiths 6.1.3–6.4 and 3.1–3.3.

Problems on this exam will be very similar to problems from the homework, examples done in class, examples in your text, and even problems on previous exams (for "old" material).

For the new material you should be able to:

- Demonstrate a physical understanding of the origin of bound currents.
- Calculate bound currents from known magnetizations.
- Determine $\mathbf{H}$ from given symmetric free current distributions.
- Know how to relate $\mathbf{B}$, $\mathbf{H}$, and $\mathbf{M}$.
- Understand derivation and consequences of the "Uniqueness Theorems."
- Use the "method of images" to calculate potentials from simple charge configurations near conductors.
- Calculate potentials using the separation of variables technique. You should be able to:

- Determine the form of the "separated" ordinary differential equations that apply in Cartesian, spherical, and cylindrical coordinates.
- Use boundary conditions to determine coefficients in potentials expressed as linear combinations of product solutions.

Equations from New Material

$$\mathbf{J}_b = \nabla \times \mathbf{M}$$

$$\mathbf{K}_b = \mathbf{M} \times \hat{\mathbf{n}}$$

$$H = \frac{1}{\mu_0}\mathbf{B} - \mathbf{M}$$

$$\nabla \times \mathbf{H} = \mathbf{J}_f \quad \longleftrightarrow \quad \oint \mathbf{H} \cdot d\mathbf{l} = I_{f_{\text{enc}}}$$

$$\mathbf{M} = \chi_m \mathbf{H}$$

$$\mathbf{B} = \mu_0(1 + \chi_m)\mathbf{H} = \mu\mathbf{H}$$

$$\nabla^2 V = -\frac{\rho}{\epsilon_0}$$

$$\begin{aligned} \int_1^1 P_l(x)P_{l'}(x)\,dx &= \int_0^\pi P_l(\cos\theta)P_{l'}(\cos\theta)\sin\theta\,d\theta \\ &= \begin{cases} 0, & \text{if } l' \neq l \\ \frac{2}{2l+1}, & \text{if } l' = l. \end{cases} \end{aligned}$$

$$\int_0^a \sin(n\pi y/a)\sin(n'\pi ya)\,dy = \begin{cases} 0, & \text{if } n' \neq n. \\ \frac{a}{2}, & \text{if } n' = n. \end{cases}$$