Physics 435 Final Information and Endgame

1) You must turn in Homework 11 by Wednesday, April 30 < 5pm to receive credit. This is the day of the last lecture.
    a) I will post all homework solutions by Wednesday evening to help you prepare.
    b) I will hold special office hours on Tuesday, April 29 from 2:30 – 4:30 pm to help with this homework.

2) Be sure to check that all of your grades are correctly recorded prior to the last day of class. In particular, make sure that your HW 3 are now correctly recorded since grades were lost due to a disk crash early in the semester.

3) The final exam will be held in 136 Loomis on Saturday, May 3rd from 8 am – 11 am
    a) The final exam will be comprehensive covering all topics in the course up to and including the Electrodynamics chapter.
    b) I will hold special office hours on Wednesday April 30 from 2:30 – 4:30 pm and on Reading Day, Thursday May 1 from 2:30 - 4:30 pm to answer questions about the final.
    c) I will work the (attached) final review problem on the Wednesday, April 30 lecture.
    d) If you arrive on time for the exam on Saturday you will have 3 hours to work the exam.
        i) There will be five problems on the final
        ii) Unlike the midterms you will need to turn in both your answers and the exam questions to receive credit.
        iii) The final exam is open book and open notes like the midterm.

Here is a problem (with some hopefully correct answers) that we will discuss on the last lecture of class on April 30 on time varying fields.

Consider a long, conducting inner cylinder of radius *a* and length L which carries a surface current of $\vec{K}_a = K\,\hat{z}$. A coaxial log cylinder of radius b and length L carries a surface current of $\vec{K}_b$ with $b > a$. Answer all parts in terms of K, a, b, L, ω, cylindrical coordinates and physical constants as needed.

(a) Find $\vec{K}_b$ that insures that $\vec{B}(s > b) = 0$. Assume this $\vec{K}_b$ is present in all parts of this problem

(b) Calculate $\vec{B}(a < s < b)$ using Ampere's Law.

(c) Compute $\vec{A}$ in all regions using $\int \vec{A} \cdot d\vec{\ell} = \int_S \vec{B} \cdot d\vec{a}$

answer: $\vec{A}(a < s < b) = -\hat{z}\mu_0 aK \ln\frac{s}{a}$

(d) Check continuity of $\vec{A}$ and discontinuity of $\frac{\partial \vec{A}}{\partial s}$ at the boundaries $s = a$ and $s = b$.

We now oscillate the inner conductor current according to $\vec{K} = K \sin\omega t\,\hat{z}$.

(e) Compute $\vec{E}$ to first order in ω using Faraday's Law. Hint- the electric field is along the z-direction and the loop integral was mostly done in part (c).

answer: $\vec{E} = \hat{z}\mu_0 aK \ln\frac{s}{a}\,\omega\cos\omega t$

(f) Check the $\vec{E}$ expression you computed in part (e) using $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$.

(g) Calculate $\vec{B}$ to second order in ω^2 by using the displacement current from the $\vec{E}$ expression you computed in part (e). This integral may be helpful

$\int \nu \ln\nu \, d\nu = \frac{\nu^2}{4}\left(2\ln\nu - 1\right)$.

answer: $\vec{B} = \hat{\phi}\frac{\mu_0 aK}{s}\sin\omega t\left[1 - \frac{\omega^2}{4c^2}\left(a^2 - s^2 + 2s^2\ln\frac{s}{a}\right) + \mathcal{O}(\omega^4)\right]$

(h) Check your result by showing $\vec{\nabla} \times \vec{B} = \frac{1}{c^2}\frac{\partial \vec{E}}{\partial t}$ in the region $a < s < b$.