Exam 2 Study Guide

This is intended as a rough guide to let you know what topics I have tried to emphasize and am thus more likely to test on.

- Basics of Magnetism
  - Similarities/Differences between Electric and Magnetic phenomena.
  - Field Shape/Behaviour of permanent (bar) magnets.
  - Forces between currents and moving charges.
- Sources
  - Fields around currents. How to find them, what the look like.
  - Be able to use Ampère's Law on systems similar to the wires, coils, co-axial cables, etc. that appear in the examples from class.
  - Understand the basic facts about ferromagnets: the respond to external fields and amplfy them.
- Faraday
  - Be able to use Faraday's Law to find induced $\mathscr{E}$ and current.
  - Apply Lenz's Law
  - Understand the different ways that flux can be changed. We've done a lot of problems where the current changes, don't forget about the others.
- Induction
  - Know what mutual and self induction are
  - Be familiar with and understand the induction examples from lecture. You should be able to find the $\mathscr{E}$ in one coil of a transfomer due to the other, or for a similar case.
  - Understand that there is energy stored in an inductor. Know that this energy is stored in the field, and builds up as the current is cranked up.
  - Be familiar with the basic behaviours of the 3 kinds of AC circuit: LR, LC, LRC. This means that you know what the charge/current does in each case (qualitatively, you don't need to memorize the equations or anything) and why. For instance, you should understand why the charge on a capacitor in an LC circuit oscillates between $+Q$ and $-Q$.
- Maxwell's Equations
  - Know about Maxwell's correction to Ampère's Law. What is it? Why is it necessary? What are some of its consequences?
  - Given Maxwell's equations, be able to describe what each equation is used for or what it tells us. For instance, know that Gauss's Law for magnetic fields means there aren't any magnetic monopoles. And know which equation I mean when I say that.
  - Know that Maxwell's correction to Ampère's Law gives rise to oscillating fields and that this leads to electromagnetic waves. Be able to give some basic understanding of how this happens, not just that it does.
- Electromagnetic Waves
  - Know how and why Maxwell's equations simplify in a vacuum.
  - Know basic facts about the $\vec{E}$ and $\vec{B}$ fields in EM waves. What is each part (wave number, frequency, etc.) and what does it mean? Know how the 2 relate (direction and magnitude).
  - Know about the velocity of light. Understand the distinction between the speed of light in a vacuum and in general.
  - Know some stuff about the different kinds of EM radiation. Not everything about each, but a little something. Also know the order in terms of frequency, and that higher frequencies have more energy.
  - Be aware of the idea that different materials will respond strongly to particular EM frequencies because of resonant frequencies. That made its way into the lecture in response to a question so it isn't in the text, but it is an interesting and important aspect of how EM waves are used. Prime example is microwaves being resonant with water and so being useful for heating up food.
  - Know about the Poynting vector and energy flow. Be able to use the Poynting vector to find the energy transferred via EM wave.
  - In particular, you should be able to solve basic problems with radiation pressure.