IPA and two large Kimtechs.

Lectures 1 and 2: PHYS242 Information

	Perpendicular Boundary Conditions	Parallel Boundary Conditions
Electric Field Bdry Cdtns	$\left(\vec{E}_1 - \vec{E}_2\right) \cdot \vec{n} = \frac{\sigma}{\epsilon_0}$	$\left(\vec{E}_1 - \vec{E}_2\right) \cdot \vec{t} = 0$
Magnetic Field Bdry Cdtns	$\left(\vec{B}_1 - \vec{B}_2\right) \cdot \vec{n} = 0$	$\left(\vec{B}_1 - \vec{B}_2\right) \cdot \vec{t} = \mu_0 \vec{J}$

Lecture 3: Introducing the Vector Potential

$$\vec{A} = \frac{\mu_0}{4\pi} \int\limits_{current} \frac{\vec{J}}{r} dV$$

$$d\vec{B}(P) = \frac{\mu_0}{4\pi} Idl \frac{\vec{t} \times \vec{r}_{QP}}{r_{QP}^3}$$

Lecture 4: Vector Potential as Electrostatics

Solving for the vector potential can be thought of as solving for the electrostatic potential where the current is replaced with a volume charge density : $c^2\rho \rightarrow J$.

Lecture 5: Relativity of Fields

Relativity of motion determines that B fields change into E fields and vice-versa. Charge value is independent of reference frame but volume (change density) is not.

Lecture 6: Deriving the Weak Formulation

Electrostatic energy can be written as

$$U_e = \int\limits_{\text{all space}} \rho\phi dV - \frac{1}{2}\epsilon_0 \int\limits_{\text{all space}} ||\nabla\phi||^2 dV$$

It can be shown that the solution for the right ϕ is determined by minimizing U_e over all ϕ (given some ρ).

Lecture 7: Using the Weak Formulation

In this lecture we derive an approximation of the capacitance between a cylindrical conductor and another concentrically spaced conductor. Study the capacitance example. Try to extend it to third order.

Lecture 8: Mutual Inductance

Conducting loops adjacent to one another will exhibit mutual inductance between both of them.

$$M_{21} = \frac{\Phi_{21}}{I_1} = \frac{\mu_0}{4\pi} \oint_{\gamma_2} \left(\oint_{\gamma_1} \frac{\vec{t_1}}{r}\ dl_1 \right) \cdot \vec{t_2}\ dl_2 \quad = \frac{\Phi_{21}}{I_1} = \frac{\mu_0}{4\pi} \oint_{\gamma_2} \oint_{\gamma_1} \frac{\vec{t_1} \cdot \vec{t_2}}{r}\ dl_1\ dl_2$$

Lecture 9: Self-Inductance of a Loop using Expansions

This lecture is particularly involved with regards to the calculations involved. I would not recommend spending much time on it to study for the midterm.

Lecture 10: Electrostatic Forces and their Relationship to Work

The particulars of how to calculate the electric force on a conductor is supplied, in general. That is:

$$F_r = -\frac{\partial U_e}{\partial r}\bigg|_q = \frac{\partial U_e}{\partial r}\bigg|_\phi$$

The special case of the electric force acting on a condenser is also considered.

Lecture 11: Work and Forces with Currents

The force acting on a current-carrying wire in a magnetic field is considered.

$$\vec{F} = \int_\tau \left(\vec{J} \times \vec{B} \right) dV$$

This expression was used to calculate the force between straight wires carrying current.

The energy required to move a conductor was considered.

Lecture 12: Multiple Expansions of Electrostatic Potential

The multipole expansion of a potential was defined in terms of Legendre polynomials.

The torque on a dipole in an electrostatic field is considered.

Lecture 13: Dipoles

The potential energy of a dipole interacting with an electric field is considered.

The electrostatic potential due to a configuration of dipoles is considered.

Finally, the surface charge density, σ, and volume charge density, ρ, of charge given by a distribution of dipoles is given.

Namely: $\sigma = \vec{P} \cdot \vec{n}$ and $\rho = -\nabla \cdot \vec{P}$