Final Syllabus

- Griffiths ch. 2-11
- Lecture notes
- exercises (including midterm)

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What do I expect you to remember (not complete)

- The Maxwell Equations
  with: consitutive relations
  Boundary Conditions
- Definition of the potentials
- Poynting's vector, energy densities
- Plane waves
- Gauge transformations
  - Lorentz Gauge (
  - Coulomb —11—
- Know how to use the divergence and Stokes th.
- The idea behind multipole expansions
- What is radiation? Retarded time.
- Biot-Savart law : $\vec{B} = \frac{\mu_0}{4\pi} \int d^3r \, \frac{\vec{J}(\vec{r}\,') \times \hat{R}}{R^2}$
- The wave eq.
- Dispersion relation

Maxwells Eq

$$\nabla \cdot \vec{D} = \rho_f$$

$$\nabla \cdot \vec{B} = 0$$

$$\nabla \times \vec{E} = -\partial_t \vec{B}$$

$$\nabla \times \vec{H} = \vec{J} + \partial_t \vec{D}$$

Consitutive relations:

$$\vec{D} = \varepsilon \vec{E}$$

$$\vec{B} = \mu \vec{H}$$

Boundary Conditions:

$$E_1^{\parallel} - E_2^{\parallel} = 0$$

$$B_1^{\perp} - B_2^{\perp} = 0$$

$$\left.\begin{aligned} D_1^{\perp} - D_2^{\perp} &= \sigma_f \\ \vec{H}_1^{\parallel} - \vec{H}_2^{\parallel} &= \vec{K}_f \times \hat{n} \end{aligned}\right\} \text{normally zero}$$

Potentials :

$$\vec{E} = -\nabla V - \partial_t \vec{A}$$

$$\vec{B} = \nabla \times \vec{A}$$

$$V(\vec{r},t) = \frac{1}{4\pi\varepsilon_0}\int d^3r' \, \frac{\rho(\vec{r}\,',t_r)}{R} \qquad R = |\vec{r}-\vec{r}\,'|$$

$$t_r = t - R/c$$

$$\vec{A}(\vec{r},t) = \frac{\mu_0}{4\pi}\int d^3r' \, \frac{\vec{J}(\vec{r}\,',t_r)}{R}$$

Gauge Transformations :

$$\vec{A}' = \vec{A} + \nabla\Lambda$$

$$V' = V - \partial_t \Lambda$$

Lorentz gauge : $\nabla\vec{A} + \varepsilon_0\mu_0 \partial_t V = 0$

Coulomb -"- : $\nabla\vec{A} = 0$.

Know how to derive the eqs. satisfied by the potentials V and $\vec{A}$.