CLASSICAL ELECTRODYNAMICS II

Homework Set 6

October 30, 2009

1. A thin linear antenna of length d is excited in such a way that the sinusoidal current makes a full wavelength of oscillation. That is, the current through the antenna can be written as

$$I = I_0 \sin \frac{2\pi z}{d} \, \mathrm{e}^{-\mathrm{i}\omega t} \ ,$$

where I_0 is a constant and $\omega = kc = 2\pi c/d$.

(a) Determine the corresponding current density $\mathbf{J}(\mathbf{r}, t)$.

(b) Calculate the electric dipole moment. Does this antenna emit electric dipole radiation? If so, at what frequency or frequencies?

(c) Calculate *exactly* the vector potential $\mathbf{A}(\mathbf{r}, t)$ in the radiation zone.

(d) Use your result from part (c) to calculate the magnetic field $\mathbf{H}(\mathbf{r}, t)$ and the electric field $\mathbf{E}(\mathbf{r}, t)$ in the radiation zone.

(e) Use your results from part (d) to calculate the power radiated per unit solid angle, and sketch the angular distribution of radiation emitted.