Engineering 7811 Tutorial 2 Winter, 2010

1. We have derived the far-field expression for the vector potential of the uniform current element to be

$$\vec{A}(\vec{r}) = \hat{z}\left(\frac{\mu I_0 \ell}{4\pi r}\right) e^{-jkr}$$

Use the definition of $\vec{\nabla} \times \vec{A}$ and the appropriate constitutive relation to find the far-field free space $\vec{H}$ (all components).

2. A hypothetical isotropic antenna is radiating into free space. At a distance of 100 m from the antenna, the total electric field has only a $\hat{\theta}$ component and is measured as 5 mV/m. Find (a) the time-average power density and (b) the radiated power.

3. The following is a review question (based on Term 5 e-m), but the main idea in it will be useful when we look at antenna arrays. (a) Two equal static charges of opposite sign separated by a distance L constitute a static electric dipole. Show that the electric potential at a distance r from such a dipole is given by

$$\Phi = \frac{QL\cos\theta}{4\pi\epsilon r^2}$$

where Q is the magnitude of each charge and θ is angle between the radius r and and the dipole axis. It is assumed that $r \gg L$. (a) Find the electric field intensity, $\vec{E}$, at a large distance from the dipole.