

ECEn 462 (Block 1)
Electromagnetic Radiation and Propagation
 Homework #6

1. Glass has a Verdet constant of approximately $V=0.015$ min/G-cm at a wavelength of $\lambda=633$ nm and the applied magnetic field is $B=1$ T. Assume that the index of refraction of the glass without a magnetic field applied is $n=1.5$.
 - a. What is the permittivity tensor
 - b. Draw the configuration to make an optical isolator
 - c. What is the thickness of the optical isolator?
 - d. If the material is changed to Terbium Gallium Garnet (TGG) crystal that has a Verdet constant of $V=-0.46$ min/G-cm, what is the new thickness of the isolator?

2. Book problem 9.2.1

3. A center-fed short dipole extends from $-L < z < L$, where L is small compared to the wavelength ($L \ll \lambda$). The current distribution along the antenna has a maximum in the center $I(z=0) = I_0$ and is zero at ends $I(z=\pm L) = 0$. Assume that the current magnitude is linear along its length. Find expressions for the following:
 - a. The electric field in the far-field
 - b. The power radiated in the far-field, P_{rad} .
 - c. The radiation resistance R_{rad}
 - d. The antenna gain function $G(\theta, \phi)$

4. A half-wave dipole is described as a current density

$$\vec{J}(r) = \hat{z} \delta(x) \delta(y) I_0 \cos(kz)$$

For $-\lambda/4 < z < \lambda/4$. Find expressions for the following

- a. The magnetic vector potential in the far-field
- b. The electric field in the far-field
- c. The power radiated in the far-field, P_{rad} . Use the fact that

$$\int_0^\pi \frac{\cos^2[(\pi/2) \cos \theta]}{\sin \theta} d\theta = 1.22$$

- d. The radiation resistance R_{rad}
- e. The antenna gain function $G(\theta, \phi)$

5. A center-fed half-wave dipole is bent in the shape of a square (see Figure 1). If the current along the length of the dipole varies as $\cos(kz)$ (similar to problem 3), what is the magnetic vector potential \vec{A} . You only need to set up the integral but not solve it.

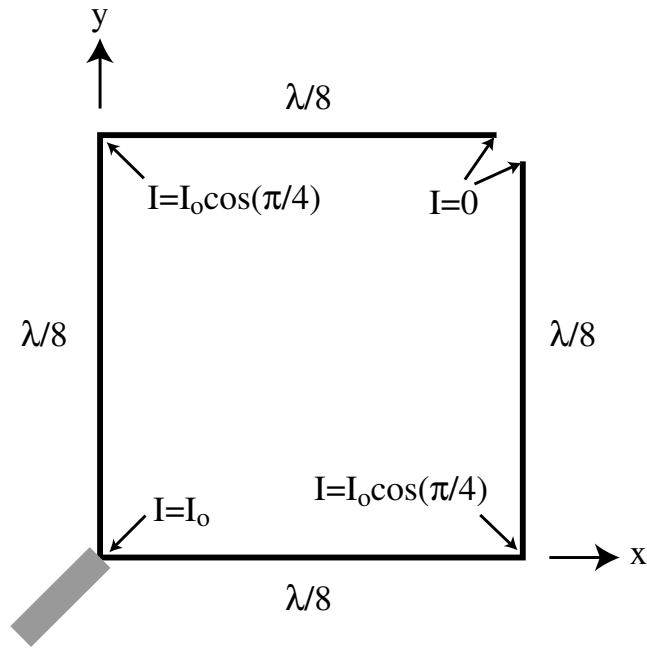


Figure 1