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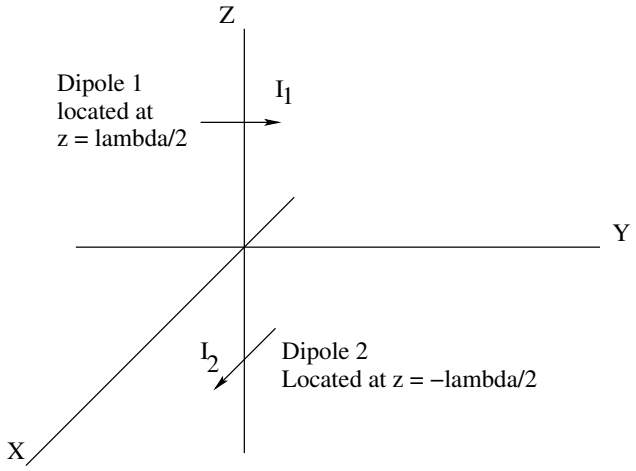
EE 252 **Spring, 2005**

SAMPLE MIDTERM

Problem 1 of 2 :

Application of the radiation Integral Consider two $\lambda/2$ dipoles oriented as shown: Dipole 1 lies in



the yz plane, parallel to the y-axis. Dipole 2 lies in the zx plane, parallel to the x-axis. Current I_1 and I_2 are in the sinusoidal steady-state with $e^{j\omega t}$ time variation.

1. What are the far-filed radiation power patters in the xy and zx planes if $I_1 = I_2$?
2. What are the power patterns in the xy and zx planes if $I_1 = I_2 e^{j\frac{\pi}{2}}$?
   Give your answers as sketches, labeling salient features. Your sketches should be drawn on seprate coordinate system but you should use the same scale for both parts (1) and (2).
   (Sketch means to provide a drawing roughly to scale, with important points and features clearly identified by quantity and location.)

Problem 2 of 2 [40 points]:

The power radiated by a lossless antenna is 5 watts. The radiation intensity (in watts per steradian) of this antenna is described in standard spherical coordinates (θ, ϕ) by the following expression:

$$U(\theta,\phi) = \begin{cases} U_0 \cos\theta \sqrt{\sin\theta \cos^2\phi} & 0 \le \theta \le \pi/2, \ -\pi/2 \le \phi \le \pi/2, \\ \\ 0 & \text{elsewhere.} \end{cases} \tag{1}$$

1. What is the value of U_0? (10 points)
2. At what angles (θ, ϕ) does one obtain the maximum directivity? (10 points)
3. What is the maximum directivity of the antenna? (10 points)
4. What is the maximum power density in watts per square meter at a distance of 1 km? (10 points)