# The University Of Texas at Dallas

# Electromagnetic Engineering I

# EE 4301

## Spring 2012
## Assignment 15

### Due Date and Time:

At the beginning of class, May 4, 2012

### Reading:

N. N. Rao, *Fundamentals of Electromagnetics for Electrical and Computer Engineering*, Chapter 9

### Problems:

Please write your answers to the following problems on engineering paper. No credit will be given for work handed in on other types of paper.

1. Sketch the array pattern for an array of 2 identical dipole antennas, both parallel to the $Z$ axis. Also sketch the antennas. The antennas are positioned along the $X$ axis, with a separation of $\lambda/2$, and are driven in phase ($\alpha = 0$). Your engineering paper is in the $XY$ plane. What is the directivity of this array?
2. Repeat the preceding problem for 4 antennas that are equally spaced along the $X$ axis, at intervals of $\lambda/2$.
3. Evaluate the effective area of a half-wavelength dipole antenna operating at the wavelength $\lambda = 2$ m, and compare your result to the effective area of a Hertzian dipole antenna with $h = .01\lambda$ operating at the same wavelength.
4. A dipole antenna of total length $h = 3$ mm is center-fed by a current that is sinusoidal in time at a frequency $f = 10$ GHz. The antenna's center is located at the origin, and the antenna points along the $z$ axis. Assuming that the phasor amplitude of the current distribution in the antenna can be approximated by the triangular function

$$\tilde{I}(z) = I_0 \left(1 - \frac{2|z|}{h}\right),$$

where $I_0 = 3$ A,

   (a) Find the electric and magnetic fields in the radiation zone. [Hint: Is $h \ll \lambda$?]
   (b) Find the Poynting vector.
   (c) Find the total power radiated.
   (d) Find the radiation resistance.
   (e) Find the directive gain.
   (f) Find the directivity.