EE 252 **Handout #4**
Len Tyler **April 1, 2005**

Problem Set #1

Due 4:30 pm Friday, April 8, 2005

Reading assignment: *Stutzman & Thiele* Sections 1.1–1.9
(Optional) *Kraus* Ch. 1, 2.1–2.13, 2.19–2.33, 2.38, 3.1–3.4, 3.13–3.16

Problems:

1. An airplane is flying at a constant height h. Its surface search radar should have a uniform electric field magnitude on the surface of the earth for $\theta_1 \leq \theta \leq \theta_2$ and $\phi_1 \leq \phi \leq \phi_2$. Find the normalized field pattern F(θ, ϕ) of the radar and its directivity. (hint : As it was seen in the ideal dipole and other examples we can assume that far field electric field can be written in the form of:
$\vec{E}(r, \theta, \phi) = \vec{E}^0(\theta, \phi)\frac{e^{-j\beta r}}{r}$
where $\vec{E}^0$ is in a superposition of $\hat{\theta}$ and $\hat{\phi}$ direction(perpendicular to $\hat{r}$)).(7 point)

2. *Stutzman & Thiele*, Problem 1.6-2 part (b) only. Please substitute (1-62) into (1-47), not into (1-45).(5 point)

3. *Stutzman & Thiele*, Problem 1.6-3.(10 point)

4. *Stutzman & Thiele*, Problem 1.7-1.(5 point)

5. *Stutzman & Thiele*, Problem 1.7-2. (15 point)
In addition:
   (a) Use Matlab to produce polar plots of $|F(\theta)|^2$, $0 \leq \theta < 2\pi$, on a dB scale for three cases: (i) $L = \lambda/4$, (ii) $L = 2\lambda$, and (iii) $L = 10\lambda$. (Note that $F(\theta) = g(\theta)f(\theta) = f(\theta)\sin\theta$, where $g(\theta) = \sin\theta$ is the element factor.) Graphically estimate the half-power beamwidth for each case, and compare the beamwidths as a function of L/λ.
   (b) For cases (i)–(iii) above, produce three-dimensional plots of $|F(\theta)|^2$ on a linear scale (see, for example, *Stutzman & Thiele*, Figure 1-10(d)). Use the Matlab surf(), surfl(), or mesh() command. You might also find the meshgrid() command helpful.

6. *Stutzman & Thiele*, Problem 1.7-4.(3 point)

7. *Stutzman & Thiele*, Problem 1.7-5.(5 point)