EE 252
Len Tyler **April 29, 2005**

PROBLEM SET #5

Due Friday, May 6, 2005

Problems:

1. Consider a wire carrying the current
   $I(z) = I_0 e^{-jk_z z}$ for $\frac{-l}{2} \leq z \leq \frac{l}{2}$

   (a) (7 points)For $k_z = k_0 cos\theta_0$, determine the radiated field.

   (b) (4 points)For $l = 10\lambda$, plot the ϕ-cut patterns (E-plane) with $\theta_0 = 0, 20, 45$. What is the role of θ_0?

   (c) (4 points)Give the beamwidth for each of the patterns in part (b). Give a formula of the beamwidth of $\frac{1}{l}$ for $\theta_0 = 0$.

   (d) (5 points)Give the directivity D_0 for $\theta_0 = 0, 20, 45$ and $l = 10\lambda$.

   (e) (10 points)Consider the case of $l = 10\lambda$. Break the wire into 20 segments so that the entire wire can be thought of as a 20-element array. Give: (1) the progressive phase associated with this array in terms of θ_0 (2) the element pattern (3) the array factor (4) compare the array pattern with that from (b) with $\theta_0 = 0$, any difference? (5) Consider the number of full lobes and nulls in the pattern from (b), how do they compare with the usual array factor full lobes and nulls?

2. (10 points) Design a linear array of isotropic elements placed along the z-axis such that the zeros of the array factor occure at $\theta = 0, 60, 120$. Assume that the elements are spaced $\lambda/4$ apart and that the progressive phase shift between them is 0.

   (a) Find the required number of elements

   (b) Determine their excitation coefficient

   (c) Write the array factor and plot it to verfiy your design.

   hint: think in complex plane

3. (5 points)*Stutzman & Thiele*, Problem 5.4-8.