Assignment #1

(Use MAT-Lab only to plot the Array radiation pattern)
(Should be submitted by 8th week)

AS1-1 A broadside array antenna is composed of four radiators. They are located on the corners of a square centered in x-y plane as shown in Fig.1. Two types of single radiator are used together. These are dipole and loop antennas. These radiators have constant current and equal length and radius ($\ell=\lambda/20$ and $b=\lambda/10$). The arrangement of the single radiators is as follows. The dipole is located vertically on y-axis while the loop is located horizontally on x-axis. The excitation currents are I_{o1} and I_{o2} respectively. Find the following:

(a) The electric field radiated by the array antenna at the far-zone point P (r, θ, Φ), and its polarization
(b) The array factor and its amplitude coefficients.
(c) Assume $I_{o1}=4I_{o2}$ and $d=\lambda/4$, **Plot the radiation pattern** of the array in E and H-planes, then from the plot find the HPBW

Hint: the far-zone electric field radiated by dipole and loop are given by

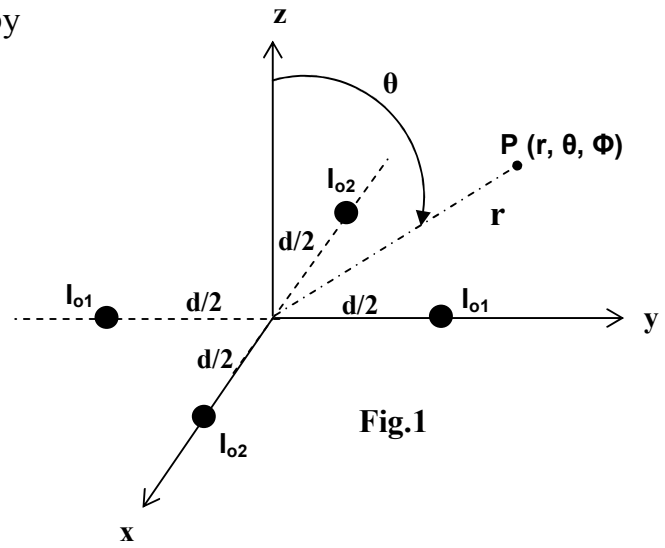

Fig.1

AS1-2 Ten isotropic radiators are located symmetrically on the x-axis as shown in Fig.2. The array elements have a constant phase excitation β and spacing $d=\lambda/2$. **Find and plot** the array factor and the total radiated field at point P (r, θ, Φ) for the following phase excitations:

(a) $\beta=0$ (b) $\beta=kd$ (c) $\beta=-kd$ (d) $\beta=-kd\cos(45^o)$

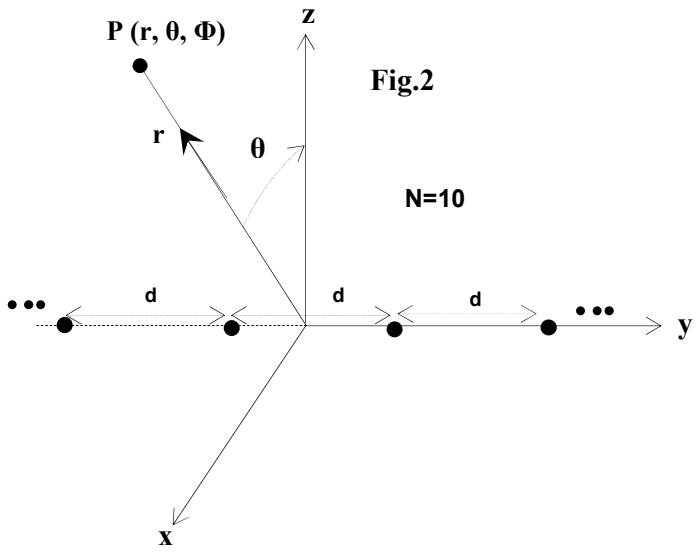

Fig.2

AS1-3 (a) Design a three isotropic-element end-fire array antenna as shown in Fig.3 for the following two amplitude windows:

1. Uniform amplitude window
2. Tschebyscheff amplitude window (SLL voltage ratio **R_V=-30dB)**

(b) **Find and plot** the normalized radiation intensity in **E** and **H**-planes of the designed array antennas in part-(a). Assume, each array element is a small circular loop of radius b and constant current I_o is located symmetrically in the x-y plane

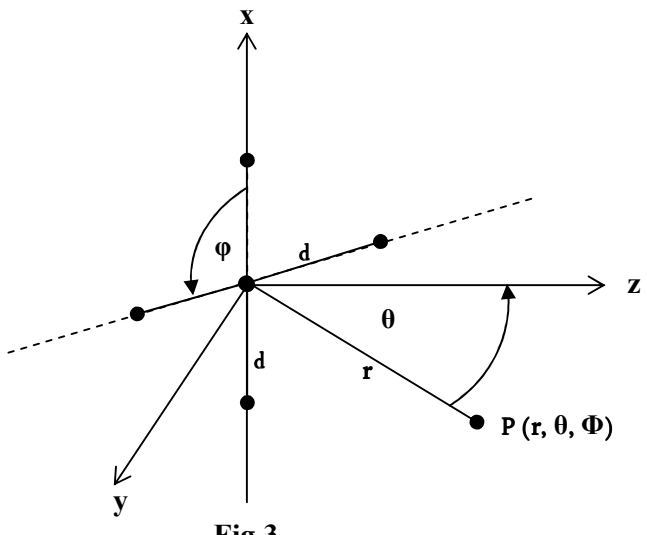

Fig.3

AS1-4 A transmitting antenna consists of two identical square apertures having length **L=4λ** is shown in Fig.4. The tangential electric fields over theses apertures are $\mathbf{E_{t1}=E_{01}a_y}$ and $\mathbf{E_{t2}=E_{02}\ a_y}$ respectively. Assume the apertures are fed by lossless square waveguide-lines with matched RF-sources. **Find and plot** the normalized radiation intensity U (θ, Φ) and the aperture efficiency ε_{ap} of the transmitting antenna for the following cases:

1. Case-I: The apertures are mounted on PEC
2. Case-II: The apertures are mounted on PMC
3. Case-III: The apertures are located in free-space region and $E_{01}=E_0$ and $E_{02}=-E_0$

Fig.4