

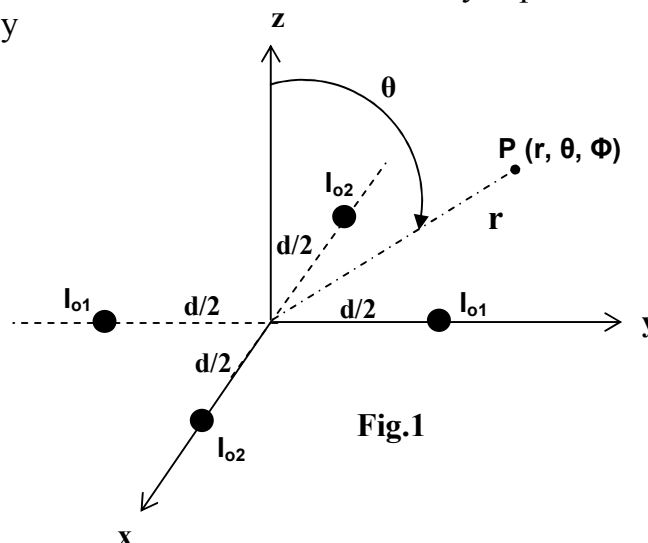
## Assignment #1

(Use **MAT-Lab only** to plot the Array radiation pattern)  
(Should be submitted by 8<sup>th</sup> 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:

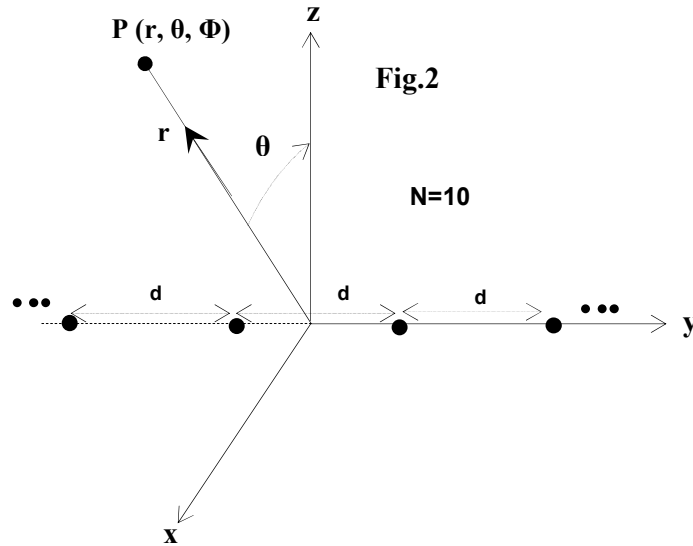
- The electric field radiated by the array antenna at the far-zone point P ( $r, \theta, \Phi$ ), and its polarization
- The array factor and its amplitude coefficients.
- Assume  $I_{o1}=4I_{o2}$  and  $d=\lambda/4$ , **Plot the radiation pattern** of the array in E and H-planes, then from the plot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

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



**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  $\beta$  and spacing  $d=\lambda/2$ . **Find and plot** the array factor and the total radiated field at point P ( $r, \theta, \Phi$ ) for the following phase excitations:

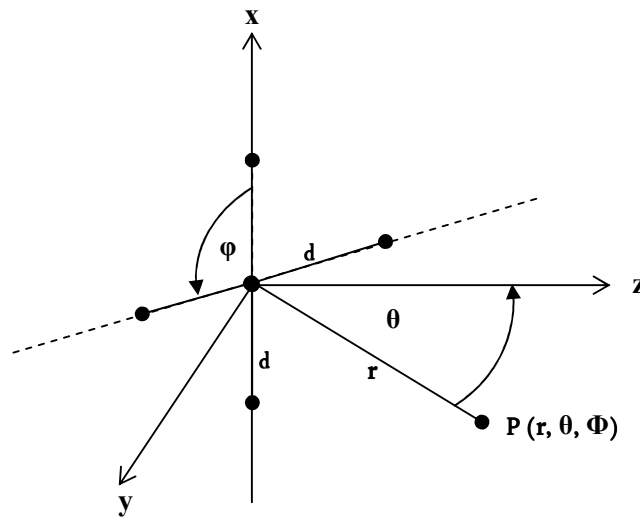
- $\beta = 0$
- $\beta = kd$
- $\beta = -kd$
- $\beta = -kd \cos(45^\circ)$



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  $R_V = -30\text{dB}$ )

(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  $I_0$  is located symmetrically in the  $x$ - $y$  plane



**AS1-4** A transmitting antenna consists of two identical square apertures having length  $L=4\lambda$  is shown in Fig.4. The tangential electric fields over these apertures are  $\mathbf{E}_{t1}=\mathbf{E}_{01}\mathbf{a}_y$  and  $\mathbf{E}_{t2}=\mathbf{E}_{02}\mathbf{a}_y$  respectively. Assume the apertures are fed by lossless square waveguide-lines with matched RF-sources. **Find and plot** the normalized radiation intensity  $U(\theta, \Phi)$  and the aperture efficiency  $\epsilon_{ap}$  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  $E_{02}=-E_0$

