# PROBLEM A3

PLOT THE RADIATION PATTERN OF AN ARRAY OF 3 ISOTROPIC RADIATORS; THE CURRENTS FEEDING THE 3 RADIATORS ARE IN PHASE AND THE DISTANCE BETWEEN TWO ADJACENT RADIATORS IS 4 cm. THE WORKING FREQUENCY IS 5,8 GHz

SOLUTION

$f = 5{,}8$ GHz $\quad \lambda = \frac{c}{f} = \frac{3\,10^8}{5{,}8\,10^9} = 5{,}17$ cm

THE SINGLE ANTENNAS ARE ISOTROPIC RADIATORS: THE TOTAL NORMALIZED RADIATION PATTERN IS GIVEN BY $|F(\theta,\varphi)| = \left|\frac{AF}{N}\right|$

$$|F(\theta,\varphi)| = \left|\frac{\sin\left(N\frac{\psi}{2}\right)}{N\sin\left(\frac{\psi}{2}\right)}\right| \qquad \psi = \frac{2\pi}{\lambda} d\cos\theta + \alpha$$

SINCE $d = 4$ cm $\lambda = 5{,}17$ cm $\quad \frac{d}{\lambda} = 0{,}77$

$\alpha = 0$ (IN PHASE RADIATORS)

- MAXIMA ARE OBTAINED FOR $\psi = 0, \pm 2\pi, \pm 4\pi, \pm 6\pi, \ldots$

$\psi = 0 \Rightarrow \quad \frac{2\pi}{\lambda} d\cos\theta = 0$

$\cos\theta = 0 \quad \theta = \pm\frac{\pi}{2} \quad (\theta = \pm 90°)$

$\psi = \pm 2\pi \quad \frac{2\pi}{\lambda} d\cos\theta = \pm 2\pi$

$\cos\theta = \pm\frac{\lambda}{d} = \pm\frac{5.17}{4}$ THERE IS NO SOLUTION

THE MAXIMA ARE OBTAINED FOR $\theta = \pm 90°$

- NULL DIRECTIONS (ZEROS) FOR $\psi = \pm \frac{2k\pi}{N}$ $k \neq N$ $k \neq 2N$ $k \neq 3N$ ...

$k = 1$ $\quad \psi = \pm \frac{2\pi}{3}$ $\quad \frac{2\pi}{\lambda} d \cos\theta = \pm \frac{2\pi}{3}$

$\cos\theta = \pm \frac{\lambda}{d} \frac{1}{3} \cong \pm 0{,}931$ $\quad \theta = \arccos(\pm 0{,}931)$

$\theta = \arccos(0{,}931)$ $\quad \theta = \pm 69{,}5°$

$\theta = \arccos(-0{,}931)$ $\quad \theta = \pm 115{,}5°$

$k = 2$ $\quad \psi = \pm \frac{4\pi}{3}$ $\quad \frac{2\pi}{\lambda} d \cos\theta = \pm \frac{4\pi}{3}$

$\cos\theta = \pm \frac{\lambda}{d} \frac{2}{3} \simeq \pm 0{,}862$ $\quad \theta = \arccos(\pm 0{,}862)$

$\theta = \arccos(0{,}862)$ $\quad \theta = \pm 30{,}5°$

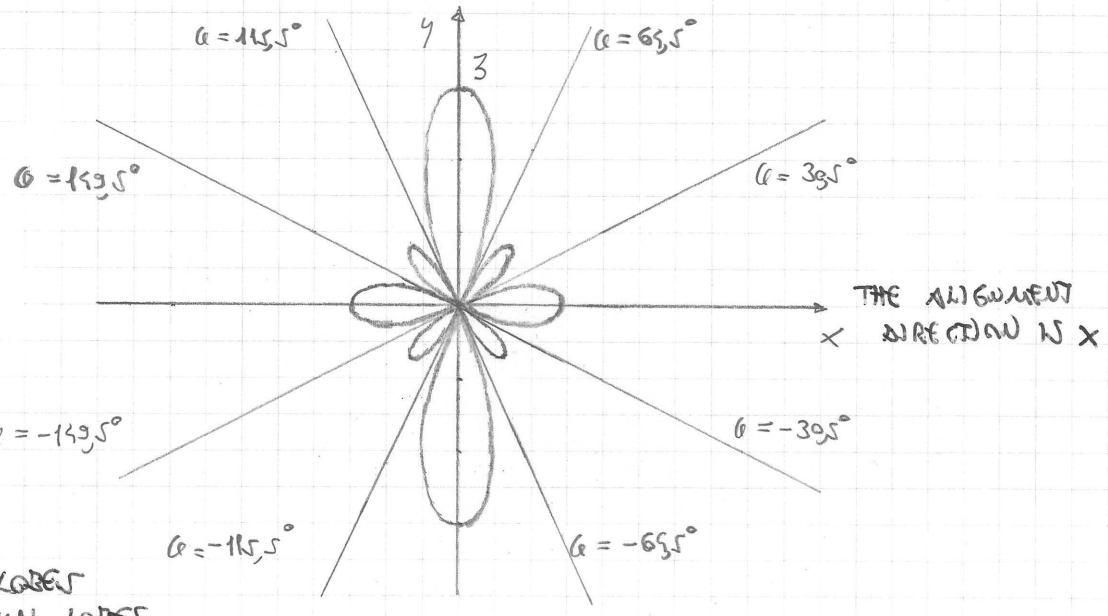
$\theta = \arccos(-0{,}862)$ $\quad \theta = \pm 149{,}5°$

$k = 4$ $\quad \psi = \pm \frac{8\pi}{3}$ $\quad \frac{2\pi}{\lambda} d \cos\theta = \pm \frac{8\pi}{3}$

$\cos\theta = \pm \frac{\lambda}{d} \frac{4}{3} \simeq 1{,}72$ THERE IS NO SOLUTION

THE NULL DIRECTIONS ARE $\pm 30{,}5°$, $\pm 69{,}5°$, $\pm 115{,}5°$, $\pm 149{,}5°$

$N|f(\theta,\varphi)|$




TWO MAIN LOBES
SIX SECONDARY LOBES