Benha University	Antennas &Wave Propagation	Electrical Eng. Dept.
Faculty of Engineering	2nd_part	4th year communication
Shoubra	-SHEET (1)	2020-2021

1-Draw the radiation pattern for finite length dipole of length $5\lambda/2$

Soln:

Consider a dipole antenna of length $l = 5\lambda/2$.

a) Analytically determine the directions of the nulls in the radiation pattern.

$$l = 5\lambda/2 \rightarrow kl = 5\pi, \ |\mathbf{E}|_n = \left|\frac{\cos\left(\frac{kl}{2}\cos\theta\right) - \cos\left(\frac{kl}{2}\right)}{\sin\theta}\right| = 0 \Rightarrow \cos\left(\frac{kl}{2}\cos\theta\right) = 0 \rightarrow \cos\theta = \frac{2n+1}{5}$$

$n = 0 \rightarrow \theta = 78.5^\circ$ $\quad$ $n = -1 \rightarrow \theta = 101.5^\circ$

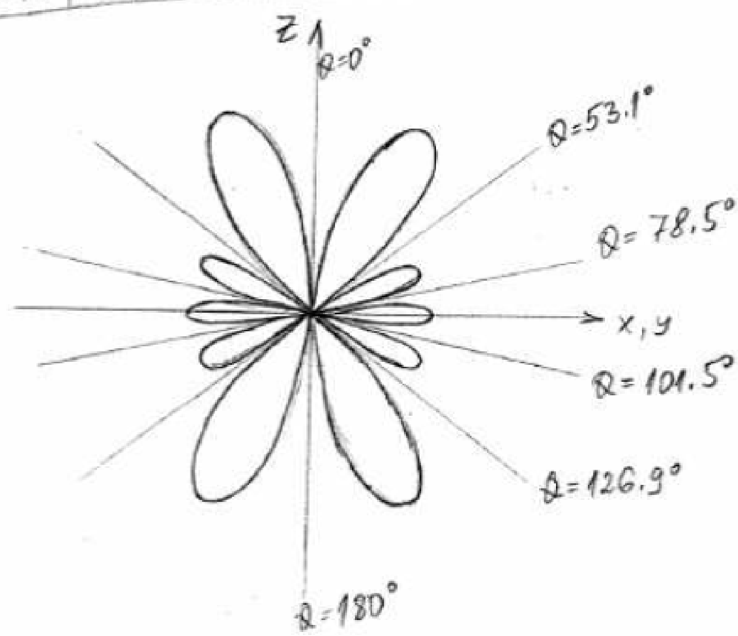
$n = 1 \rightarrow \theta = 53.1^\circ$ $\quad$ $n = -2 \rightarrow \theta = 180^\circ$

$n = 2 \rightarrow \theta = 0^\circ$ $\quad$ $n = -3 \rightarrow \theta = 0^\circ$

b) Generate a plot of the normalized radiation pattern.

b)

θ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
$\|\vec{E}\|_n$	0	0.686	1.333	1.737	1.501	0.430	0.816	0.956	0.209	1



2- For $En = \cos(\frac{\pi}{2}\cos\theta + \pi/4)$ Draw the radiation pattern

Solution:

θ_{null} at $\frac{\pi}{2}\cos\theta_n + \frac{\pi}{4} = (2n+1)\frac{\pi}{2} \longrightarrow \theta_{null} = \cos^{-1}[2n+0.5]$ → $n=0$ $\theta_{null} = 60^\circ$; $n=1$ ×

θ_{max} at $\frac{\pi}{2}\cos\theta_m + \frac{\pi}{4} = \pm n\pi$ $\quad \theta_{max} = \cos^{-1}(2n-0.5) \longrightarrow n=0$ $\theta_{max} = 120$; $n=1$ ×

	0	10	20	30	40	50	60	70	80
$\lvert AF_n \rvert$	.707	.69	.637	.543	.406	.22	0	.245	.49
θ	90	100	110	120	130	140	150	160	170
$\lvert AF_n \rvert$	.707	.87	.969	1	.975	.913	.839	.77	.723
θ	180								
$\lvert AF_n \rvert$	.707