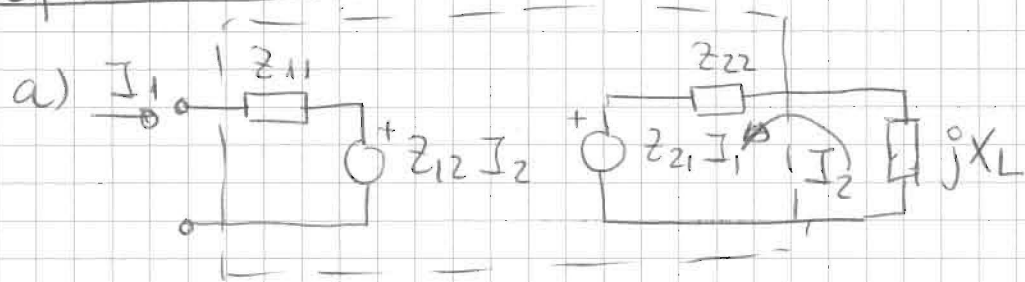


Ejercicio 1



$$\frac{I_2}{I_1} = - \frac{Z_{21}}{Z_{22} + jX_L}$$

b) Máximo $-x \rightarrow \angle \left(\frac{I_2}{I_1} \right) = Kd = 90^\circ$

c) $\angle \left(\frac{I_2}{I_1} \right) = 90^\circ = 180^\circ + \angle(Z_{21}) - \angle(Z_{22} + jX_L)$
 $\angle(Z_{22} + jX_L) = 55.4^\circ$
 $\tan(55.4^\circ) = \frac{42 + X_L}{73} \rightarrow X_L = 64 \Omega$

d) $I_2/I_1 = 0.38 \angle 90^\circ$

$$\vec{E} = \theta j 60 I_1 \frac{e^{jkr}}{r} \frac{\cos(\pi/2 \cos\theta)}{\sin\theta} \left(1 + j 0.38 j \frac{\pi}{2} \sin\theta \cos\theta \right)$$

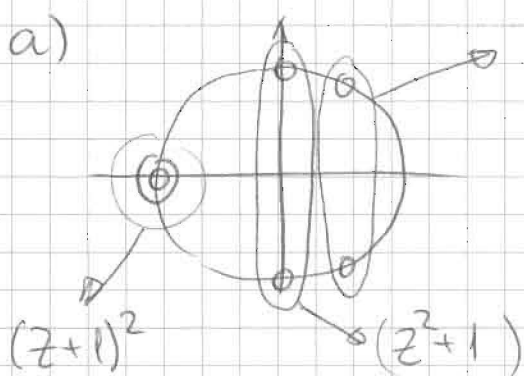
e) $Z_{in} = Z_{11} + Z_{12} \frac{I_2}{I_1} = 83.7 + j 57.5 \Omega$

$$|E|_{max} = 60 \cdot 1.38 \frac{|I_1|}{r}$$

$$D = \frac{|E|_{max}^2}{\eta} \frac{4\pi r^2}{|I_1|^2 83.7} = 2.73 = 4.3 \text{ dB}$$

Ejercicio 2

a)



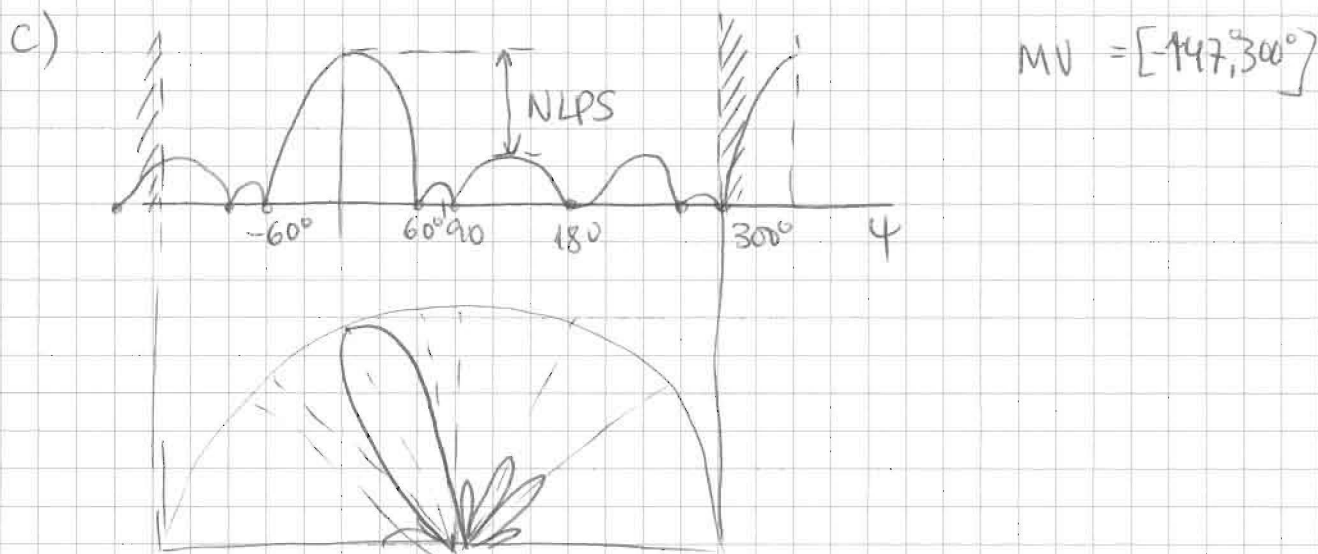
$$z^2 - 2 \cos 60^\circ + 1 = z^2 - z + 1$$

$$P(z) = (z^2 - z + 1)(z^2 + 1)(z + 1)^2$$

$$a_n = \{ 1 : 1 : 1 : 2 : 1 : 1 : 1 \}$$

b) Máxima directividad \rightarrow MV mayor posible sin lóbulos de difracción

$$\left. \begin{aligned} \psi_{\max} = 0 &= kd \cos \theta_{\max} + \alpha \\ \psi_{\text{extremo MV}} = 300^\circ &= kd + \alpha \end{aligned} \right\} \begin{aligned} d &= 0.62\lambda \\ \alpha &= 76^\circ \end{aligned}$$



$$\begin{aligned} d) \quad 60^\circ &= kd \cos \theta_{n1} + \alpha \rightarrow \theta_{n1} = 94.1^\circ \\ -60^\circ &= kd \cos \theta_{n2} + \alpha \rightarrow \theta_{n2} = 127.6^\circ \end{aligned} \quad \Delta \theta_n = 33.5^\circ$$

$$FA = \frac{\sin(\psi/2)}{\sin(\psi/2)} + 1$$

$$FA(\psi=0) = 8$$

$$1^{\text{er}} \text{ lób. } |FA(\psi=75^\circ)| = 0.63$$

$$2^\circ \text{ lób. } |FA(\psi=135^\circ)| = 2$$

$$NLPS = \frac{FA(\psi=0)}{FA(\psi=135^\circ)} = 4 = 12 \text{ dB}$$

Ejercicio 3

a) De la gráfica $\rightarrow d_m = 5.5\lambda = 19.6 \text{ cm}$

$$D = \frac{4\pi}{\lambda^2} \pi \left(\frac{d_m}{2}\right)^2 \eta$$

$\eta \approx 0.5$

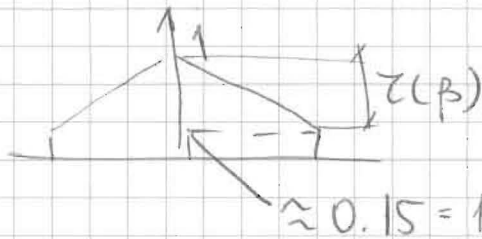
$$l_c = 10\lambda = 35.6 \text{ cm.}$$

b) $\beta = 16.9^\circ$

$$Z(\beta) = \underbrace{40 \log(\cos(\beta/2))}_{-0.7 \text{ dB}} + \underbrace{10 \log(t(\beta))}_{-15.5 \text{ dB}} \approx -16.2 \text{ dB}$$

$$\frac{dm}{n} \sin(\beta) = 1.7$$

c)



$$E_a \approx (1 - 0.85 \frac{P}{D_{a/2}})$$

$$\eta_{il} = \frac{1}{\pi (\frac{D_a}{2})^2} \frac{\left| \int_0^{2\pi} \int_0^{D_a/2} (1 - 0.85 \frac{P}{D_{a/2}}) \rho \cdot d\rho d\phi \right|^2}{\int_0^{2\pi} \int_0^{D_a/2} (1 - 0.85 \frac{P}{D_{a/2}})^2 \rho d\rho d\phi}$$

$$\approx 0.83$$

d) $D = \frac{4\pi}{d^2} A_{geo} \eta_T \rightarrow \eta_T = 0.71$

e) $D = \frac{4\pi}{d^2} A_{ge} \eta_T \approx \frac{4\pi}{(\Delta\theta_3)^2} \rightarrow \Delta\theta_3 = 0.01^\circ$

\downarrow
 ≈ 0.7

Precisión necesaria $\rightarrow \frac{\Delta\theta_3}{2} = 0.005^\circ$

TEST

Permutación 0 : b c d a c b c d b d b b

" 1 : d a c c b c d b b b b d