Clase #3 INEL 5306

$$V_n(z) = V_{on}^{+} e^{-j\beta z} + V_{on}^{-} e^{+j\beta z}$$

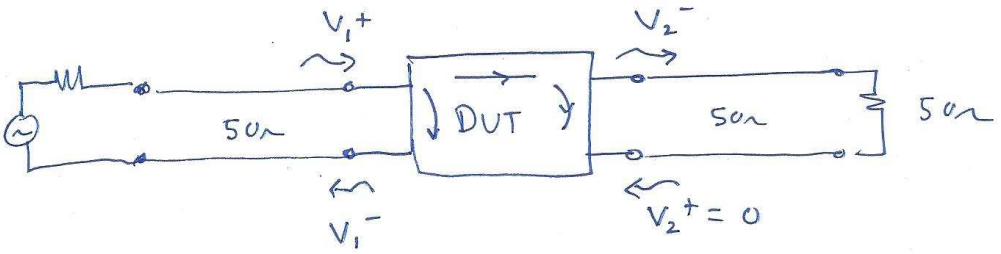
$$V_n(z) = V_n^{+} + V_n^{-}$$

Puerto #1 : $V_1 = V_1^{+} + V_1^{-}$

#2 : $V_2 = V_2^{+} + V_2^{-}$

$[S]$ → describe completamente el circuito relacionando voltajes incidentes con reflejados en los puertos del circuito. Son # complejos!!

$$S_{11} = |S_{11}| \angle \theta_{S_{11}}$$



$$S_{11} = \left.\frac{V_1^-}{V_1^+}\right|_{V_2^+ = 0} \qquad S_{21} = \left.\frac{V_2^-}{V_1^+}\right|_{V_2^+ = 0}$$

De la misma forma:

$$S_{22} = \left.\frac{V_2^-}{V_2^+}\right|_{V_1^+=0} \qquad S_{12} = \left.\frac{V_1^-}{V_2^+}\right|_{V_1^+=0}$$

$$V_1^- = S_{11}V_1^+ + S_{12}V_2^+$$

$$V_2^- = S_{21}V_1^+ + S_{22}V_2^+$$

$$\begin{bmatrix} V_1^- \\ V_2^- \end{bmatrix} = \underbrace{\begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}}_{[S]} \begin{bmatrix} V_1^+ \\ V_2^+ \end{bmatrix}$$

En general:

$$S_{ij} = \left.\frac{V_i^-}{V_j^+}\right|_{V_k^+=0} \quad (k \neq j)$$

sale por puerta i

incidente en puerta j

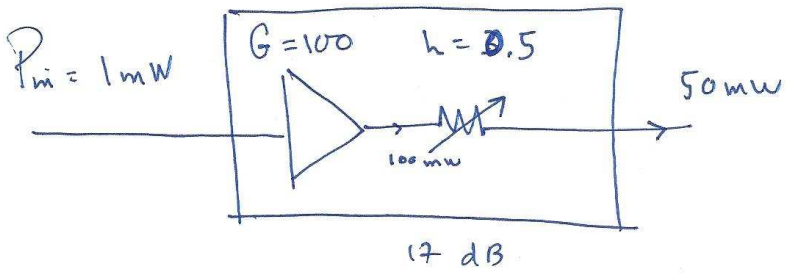
$$\begin{bmatrix} V_1^- \\ V_2^- \\ \vdots \\ V_n^- \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} & \cdots & S_{1N} \\ S_{21} & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ S_{N1} & \cdots & \cdots & S_{NN} \end{bmatrix} \begin{bmatrix} V_1^+ \\ V_2^+ \\ \vdots \\ V_N^+ \end{bmatrix}$$

(S_{N1}: V_1^+; S_{12}: V_2^+)

Uso de decibeles:

— Razones de potencia la expresa en dB

$$10 \log \frac{P_1}{P_2} \text{ dB}$$



$$G_{dB} = 10 \log 100 = 20 \text{ dB}$$

$$L_{dB} = 10 \log(.5) = -3 \text{ dB}$$

Usaremos referencia para expresar en dB valores absolutos.

$$P_{in_{dBm}} = 10 \log \frac{P_{in}}{1mW} \text{ dBm}$$

$$= 10 \log \frac{1mW}{1mW} = \underline{0 \text{ dBm}}$$

$P_{out\,dBm} = 0\,dBm + 20 - 3 = 17\,dBm$

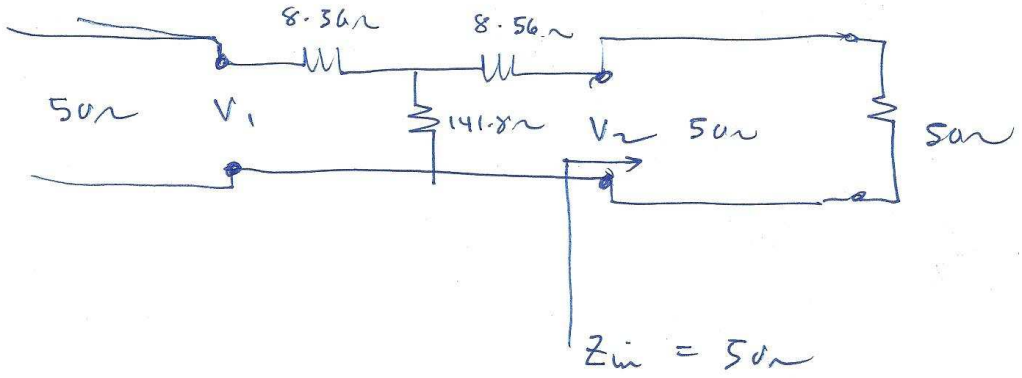
$\Longrightarrow \quad 10 \log \frac{P_{out}}{1mW} = 17\,dBm$

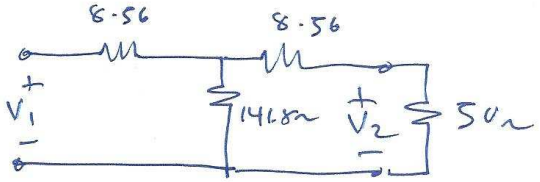
$P_{out} = (10^{1.7})(1mW) = 50\,mW$

$\Longrightarrow \quad 10 \log \frac{P}{1W} \quad dBW$

100 mW	$\longrightarrow$	20 dBm
20 mW	$\longrightarrow$	13 dBm
8 mW	$\longrightarrow$	9 dBm
4 mW	$\longrightarrow$	6 dBm
2 mW	$\longrightarrow$	3 dBm
1 mW	$\longrightarrow$	0 dBm
0.5 mW	$\longrightarrow$	−3 dBm
.25 mW	$\longrightarrow$	−6 dBm

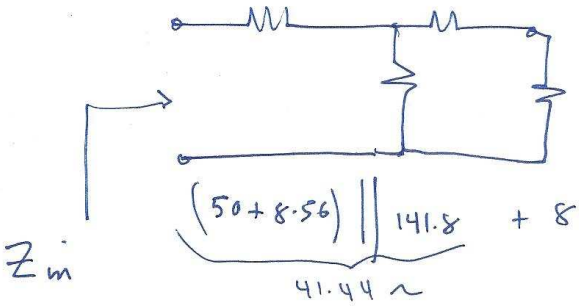
Ejemplo:





$V_1 = V_1^+ + V_1^-$ $\qquad$ $V_2 = V_2^+ + V_2^-$

S_{11}



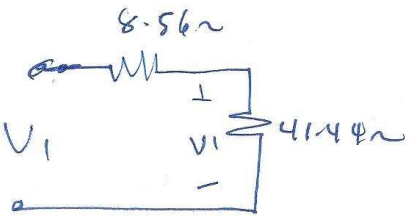
$$\therefore \quad S_{11} = \frac{Z_{in} - Z_0}{Z_{in} + Z_0} = 0$$

$$V_1^+ = V_1^+ + \cancel{V_1^-}^{\,0} = V_1^+$$

$$= V_1^+ (1 + \cancel{S_{11}}^{\,0}) = V_1^+$$

$$V_2 = \cancel{V_2^+}^{\,0} + V_2^- = V_2^-$$

$$\therefore \quad S_{21} = \frac{V_2^-}{V_1^+}$$



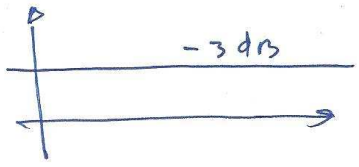
$$V' = \frac{(V_1)(41.44)}{41.44 + 8.56} = \frac{41.44}{50} V_1^+$$

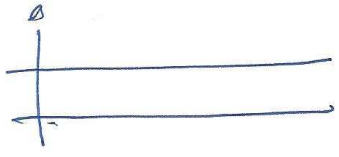
$$V_2 = \frac{(V')(50)}{50 + 8.56} = \frac{\left(\frac{41.44}{\cancel{50}} V_1^+\right)(\cancel{50})}{50 + 8.56} = .707 V_1^+$$

$$\frac{V_2^-}{V_1^+} = S_{21} = .707 \qquad |S_{21}| = .707$$

$$\theta = 0^\circ$$

$$|S_{21}|_{dB} = 20 \log .707 = -3\,dB$$



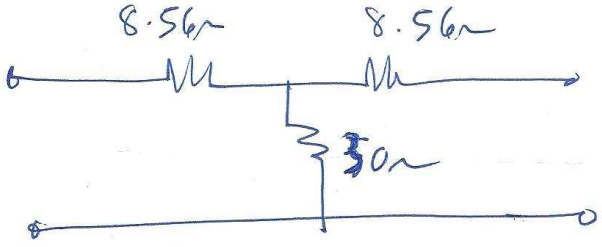


De la misma forma

$S_{12} = .707 \qquad S_{22} = 0$

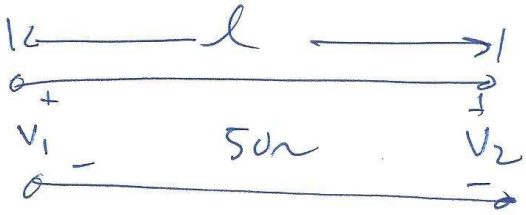
$$[S] = \begin{bmatrix} 0 & .707 \\ .707 & 0 \end{bmatrix}$$

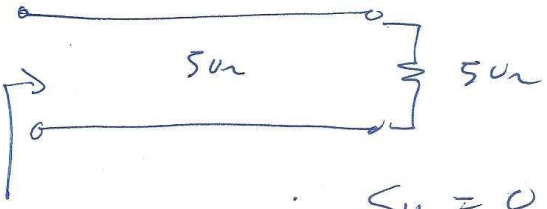
Asignación:



$$[S] = \begin{bmatrix} -.275 & .432 \\ .432 & -.275 \end{bmatrix}$$

[5] para linea de transmisão





$Z_{in} = 50\Omega$ $\therefore$ $S_{11} = 0$

$S_{22} = 0$

Em linea $V(z) = V_0^+ e^{-j\beta z} + V_0^- e^{+j\beta z}$

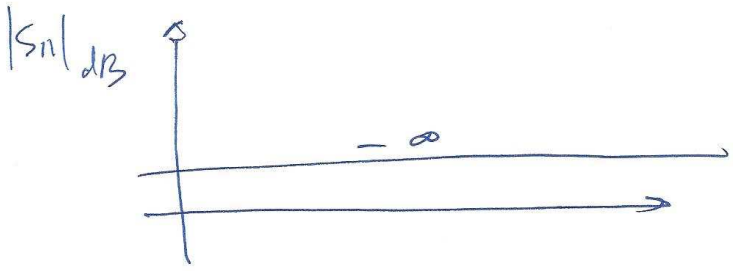
$V_1 = V(z=-l) = V_0^+ e^{j\beta l} + 0$

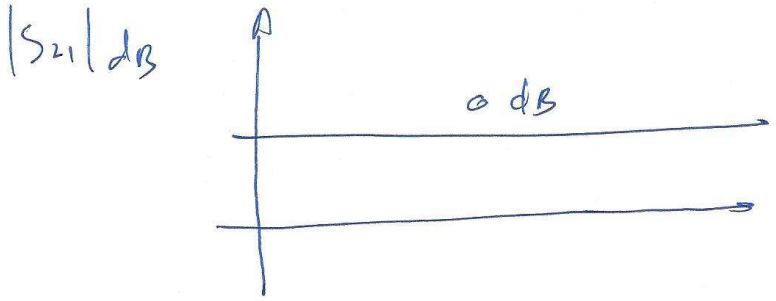
$V_1 = V_1^+ + V_1^- = V_1^+ = V_0^+ e^{+j\beta l}$

$V_2 = \cancel{V_2^+}^{\,0} + V_2^- = V_2^- = V(z=0) = V_0^+ e^{j0}$

$= V_0^+$

$\therefore \quad \frac{V_2^-}{V_1^+} = \frac{V_0^+}{V_0^+ e^{j\beta l}} = e^{-j\beta l}$



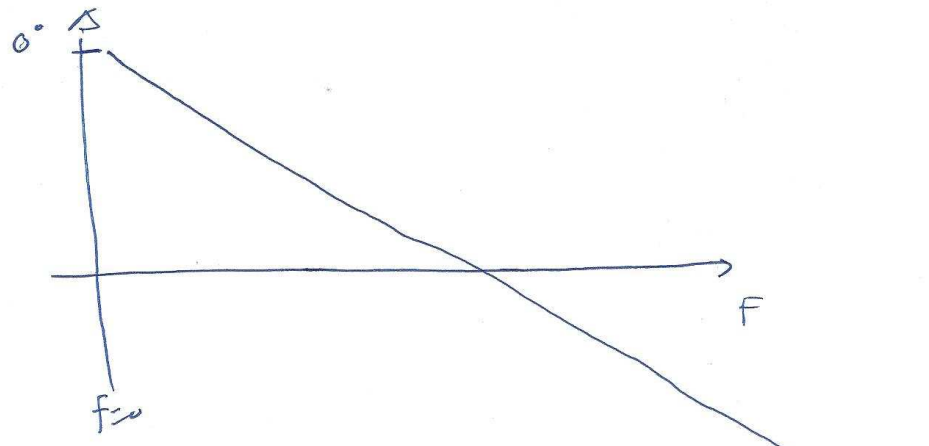


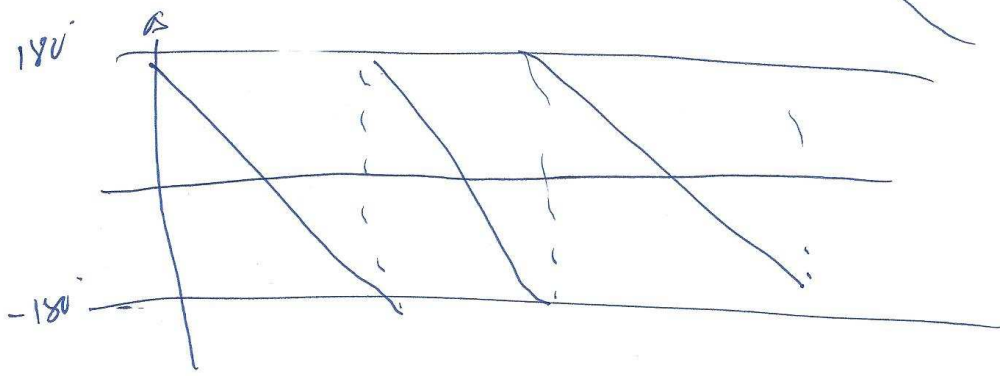
$\theta_{S_{21}}$

$= -\beta l$

$= -\frac{2\pi}{\lambda} l$

$= -\frac{2\pi}{c} f l$





Simetría:

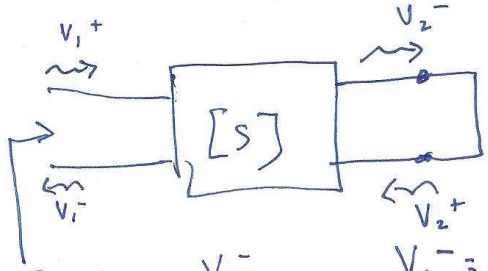
$$S_{nm} = S_{mn}$$

$$[S] = [S]_t$$

$$[S] = \begin{bmatrix} .1\angle 0^\circ & .8\angle 90^\circ \\ .8\angle 90^\circ & .2\angle 0^\circ \end{bmatrix}$$

$$[S]_t = \begin{bmatrix} .1\angle 0^\circ & .8\angle 90^\circ \\ .8\angle 90^\circ & .2\angle 0^\circ \end{bmatrix} \checkmark$$

Ejemplo.



$\Gamma = -1$

$\frac{V_2^+}{V_2^-} = -1$

$\Gamma_{11} = ? \quad \frac{V_1^-}{V_1^+}$

$V_1^- = 0.1V_1^+ + j\,0.8V_2^+$

$V_2^- = j\,0.8V_1^+ + 0.2V_2^+$

$V_1^- = 0.1V_1^+ - j\,0.8V_2^-$

$V_2^- = j\,0.8V_1^+ - 0.2V_2^-$

$$V_2^- = \frac{j0.8V_1^+}{1.2}$$

$$V_1^- = 0.1V_1^+ - j0.8\left(\frac{j0.8V_1^+}{1.2}\right)$$

$$\frac{V_1^-}{V_1^+} = \Gamma_{11} = \underline{\underline{0.633}}$$