Problema 2

a)

$$\boxed{Z_V = \frac{V_1}{I_1} \underset{T}{=} \frac{AV_2 - BI_2}{CV_2 - DI_2} \underset{V_2 = -ZI_2}{=} \frac{-AZI_2 - BI_2}{-CZI_2 - DI_2} = \frac{AZ + B}{CZ + D}}$$

b)

Si V_A es la salida del amplificador de diferencia (abajo)

Si V_B es la salida del amplificador sumador (arriba)

$$\boxed{I_1 = \frac{V_1}{R}} \quad (A)$$

$$\left.\begin{cases} V_A = V_B - V_2 \\ V_B = -V_A - V_1 \end{cases}\right\} \Rightarrow \boxed{V_A = \frac{-V_1 - V_2}{2}} \quad \boxed{V_B = \frac{-V_1 + V_2}{2}}$$

$$\boxed{I_2 = \frac{V_2 - V_B}{2R} + \frac{V_2 - V_B/2}{R} = \frac{2V_2 + V_1}{2R}} \quad (B)$$

Si $\underline{\underline{I_2 = 0}}$

(B): $\frac{2V_2 + V_1}{2R} = 0 \Rightarrow V_1 = -2V_2 \quad (A = -2)$

(A): $I_1 = \frac{V_1}{R} = -\frac{2}{R} V_2 \quad (C = -2/R)$

Si $\underline{\underline{V_2 = 0}}$

(B): $I_2 = \frac{V_1}{2R} \Rightarrow V_1 = -2R(-I_2) \quad (B = -2R)$

(A): $I_1 = \frac{V_1}{R} = -2(-I_2) \quad (D = -2)$

$$T = \begin{bmatrix} -2 & -2R \\ -2/R & -2 \end{bmatrix}$$

c)

i) $$\underset{\text{Adaptada}}{Z_v(y=0)} = \underset{\lambda/4}{\sqrt{L_0/C_0}} = \frac{Z_2^2}{Z_v^{\text{cuadripolo}}} = \underset{\text{por parte a)}}{\frac{Z_2^2}{R}} \Rightarrow \boxed{Z_2^2 = R\sqrt{\frac{L_0}{C_0}}}$$

ii) $$\underset{\text{Adaptada sin pérdidas}}{V_{pl}(x) = V_1 e^{-j\beta_1 x}} \quad ; \quad \text{Cond. de borde: } \underline{V_{pl}(x=0) = V = V_1}$$

$$\Rightarrow \boxed{V_{pl}(x) = V e^{-j\beta_1 x}}$$

iii) $$\underset{\text{sin pérdidas}}{V_{se}(y) = V_1 e^{-j\beta_2 y} + V_2 e^{j\beta_2 y}} \quad ; \quad \text{Cond. de borde: } \underline{V_{se}(y=0) = V_{pl}(x=l_1)}$$

$$\left.\begin{array}{l} \Rightarrow V_1 + V_2 = V e^{-j\beta_1 l_1} \\ \text{Además } \rho_{T_2} = \dfrac{R - Z_2}{R + Z_2} = \dfrac{V_2}{V_1} e^{2j\beta_2 l_2} \end{array}\right\} \Rightarrow \left\{ \begin{array}{l} \boxed{V_1 = \dfrac{e^{-j\beta_1 l_1}}{1 + \rho_T / e^{2j\beta_2 l_2}} V} \\ \boxed{V_2 = \dfrac{\rho_T e^{-j\beta_1 l_1}}{e^{2j\beta_2 l_2} + \rho_T} V} \end{array} \right.$$

iv)

Considerando el cuadripolo T:

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ V_2/R \end{bmatrix} \Rightarrow V_1 = A V_2 + B \frac{V_2}{R} \Rightarrow V_2 = \frac{V_1}{A + B/R}$$

$$V_1 = V_{se}(y = l_2) \Rightarrow V_R = V_2 = \frac{V_{se}(y = l_2)}{-4}$$

$$\boxed{V_R = -\frac{1}{4} V_{se}(y = l_2)}$$

$$\boxed{v_R(t) = R_e\{V_R e^{j\omega t}\}}$$