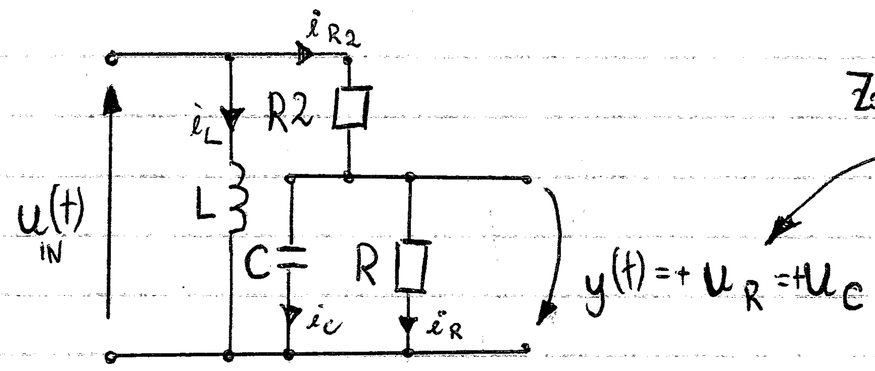

Założono napięcie odwrotnie sprzężone do napięcia sygnału wejściowego. Zostało to objęte w obliczeniach.

niech zmiennymi stanu są $x_1 = u_C$ oraz $x_2 = i_L$

$$\frac{di_L}{dt} L = u_{IN} \rightarrow \dot{i}_L = \frac{u_{IN}}{L}$$

$$\frac{d(-u_C)}{dt} C = i_C \rightarrow -\dot{u}_C = \frac{1}{C} i_C = \frac{1}{C}\left(i_{R_2} - i_R\right) = \frac{1}{C}\left(\frac{u_{R2}}{R_2} - \frac{u_C}{R}\right) =$$

$$= \frac{1}{C}\left(\frac{u_{IN} - u_C}{R_2} - \frac{u_C}{R}\right) = \frac{1}{C}\left(\frac{u_{IN}}{R_2} - u_C\left(\frac{1}{R_2} + \frac{1}{R}\right)\right) = \frac{1}{R_2 C} u_{IN} - \frac{R+R_2}{CRR_2} u_C$$

$$\dot{u}_C = \frac{-1}{R_2 C} u_{IN} + \frac{R+R_2}{CRR_2} u_C$$

$$\begin{bmatrix} \dot{u}_C \\ \dot{i}_L \end{bmatrix} = \underbrace{\begin{bmatrix} \frac{R+R_2}{CRR_2} & 0 \\ 0 & 0 \end{bmatrix}}_{A} \begin{bmatrix} u_C \\ i_L \end{bmatrix} + \underbrace{\begin{bmatrix} \frac{-1}{R_2 C} \\ \frac{1}{L} \end{bmatrix}}_{B} u_{IN}, \quad y = \underbrace{\begin{bmatrix} 1 & 0 \end{bmatrix}}_{C} \begin{bmatrix} u_C \\ i_L \end{bmatrix}$$

$$[sI-A]^{-1} = \begin{bmatrix} s - \frac{R+R_2}{CRR_2} & 0 \\ 0 & s \end{bmatrix}^{-1} = \frac{1}{s\left(s - \frac{R+R_2}{CRR_2}\right)} \begin{bmatrix} s & 0 \\ 0 & s - \frac{R+R_2}{CRR_2} \end{bmatrix} = \begin{bmatrix} \frac{1}{s - \frac{R+R_2}{CRR_2}} & 0 \\ 0 & \frac{1}{s} \end{bmatrix}$$

$$G(s) = C[sI-A]^{-1}B = [1\,0] \begin{bmatrix} \frac{1}{s - \frac{R+R_2}{RR_2C}} & 0 \\ 0 & \frac{1}{s} \end{bmatrix} \begin{bmatrix} -\frac{1}{CR_2} \\ \frac{1}{L} \end{bmatrix} = \begin{bmatrix} \frac{1}{s - \frac{R+R_2}{RR_2C}} & 0 \end{bmatrix} \begin{bmatrix} \frac{-1}{CR_2} \\ \frac{1}{L} \end{bmatrix} =$$

$$= -\frac{1}{CR_2} \cdot \frac{1}{s - \frac{R+R_2}{RR_2C}} = \frac{-1}{sR_2C - \frac{R+R_2}{R}} = \frac{-R}{sRR_2C - R - R_2} = \frac{R}{-sRR_2C + R + R_2}$$