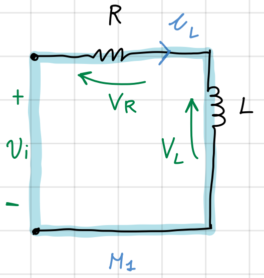
Circuito Ohmico Induttivo (VENTILATORE)

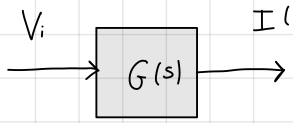


- $v_R = R \cdot i_L$
- $v_L = L \cdot \dfrac{di_L}{dt}$
- $LKT_{M_1}: \; v_i - v_L - v_R = 0$

$\overset{\mathcal{L}}{\rightleftarrows}$

- $V_R = R\, I(s)$ (1)
- $V_L = sL\, I(s)$ (2)
- $V_i(s) - V_L(s) - V_R(s) = 0$ (3)

OBBIETTIVO



$$I(s) \overset{(2)}{=} \frac{1}{sL} \cdot V_L(s) \overset{(3)}{=} \frac{1}{sL}\left(V_i(s) - V_R(s)\right) = \frac{1}{sL}\left(V_i(s) - R\,I(s)\right)$$

$$= I(s) + \frac{R}{sL} I(s) = \frac{1}{sL} V_i(s)$$

$$= \triangleright \; \frac{I(s)}{V_i(s)} = \frac{\frac{1}{sL}}{1 + \frac{R}{sL}} = \boxed{\frac{1}{sL + R}} \quad G(s)$$

$$-\triangleright \; G(s) = \underbrace{\frac{1}{R}}_{\left[\frac{1}{\Omega}\right]} \cdot \frac{1}{s\left(\frac{L}{R}\right) + 1}$$

Costante di Tempo

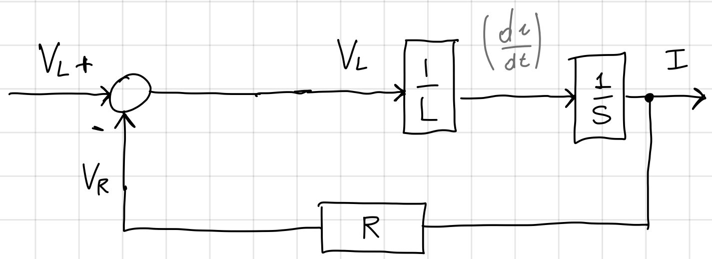
Evidenzia la forma : $\dfrac{1}{sT + 1}$

costante di Tempo

La funzione di trasferimento in questione **ha una dimensione**!

FOTO 1

SCHEMA A BLOCCHI



$$\frac{I(s)}{V_i(s)} \quad \frac{\frac{1}{sL}}{1 + R \cdot \frac{1}{sL}} = \frac{1}{sL + R}$$

SPAZIO DI STATO

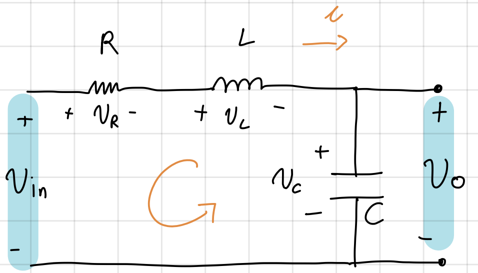
$u = v_i \qquad y = i \qquad x = i$

$$\begin{cases} \dot{x} = \frac{1}{L}\left(u - R \cdot x\right) \\ y = x \end{cases}$$

Reciproco della costante di T

$$\begin{cases} \dot{x} = -\frac{R}{L} x + \frac{1}{L} u \\ y = x \end{cases} \sim \begin{cases} \dot{x} = \underline{\underline{A}} x + \underline{\underline{B}} y \\ y = \underline{\underline{C}} x + \underbrace{\underline{\underline{D}}}_{1 \times 1} u \end{cases}$$

CIRCUITO RLC



$$\begin{cases} V_R = R\,i \\ V_L = L\,\frac{di}{dt} \\ i_c = C\,\frac{dV_o}{dt} \\ V_1 - V_0 - V_L - V_R = 0 \quad \rightarrow \quad V_o = V_i - V_L - V_R \end{cases}$$

$x_1 = i \qquad x_2 = V_o$ ↑ Var Stato ↑ $\qquad u = V_i$ IN $\qquad y = V_o$ OUT

$$\dot{x}_1 = \frac{1}{L}\left(u - V_o - R x_1\right)$$

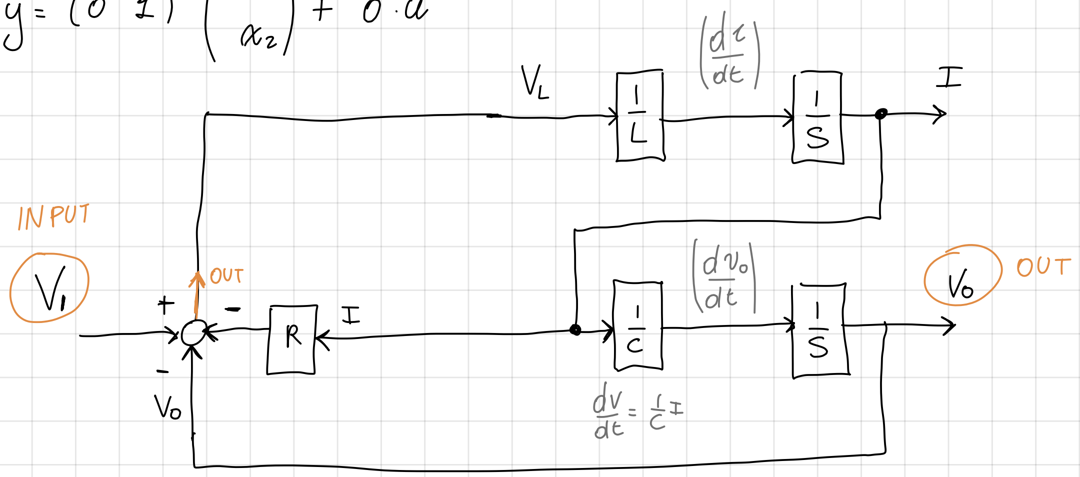
$$\dot{x}_2 = \frac{1}{C} x_1$$

$$y = x_2$$

$$\begin{cases} \dot{x}_1 = -\frac{R}{L} x_1 - \frac{1}{L} x_2 + \frac{1}{L} u \\ \dot{x}_2 = \frac{1}{C} x_1 \\ y = x_2 \end{cases}$$

$$\begin{cases} \dot{x} = \begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \underbrace{\begin{pmatrix} -\frac{R}{L} & \frac{1}{L} \\ \frac{1}{C} & \emptyset \end{pmatrix}}_{\underline{\underline{A}}} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \underbrace{\begin{pmatrix} \frac{1}{L} \\ \emptyset \end{pmatrix}}_{\underline{\underline{B}}} u \\ y = (0 \;\; 1) \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + 0 \cdot u \end{cases}$$

X2 punto è influenzata da u, ma non direttamente!



Troviamo $G(s)$ tra V_i e V_o

(1) $\quad V_o = \frac{1}{SC} \cdot I = \frac{1}{SC} \cdot \left(\frac{1}{SL} V_L\right) = \frac{1}{SC} \cdot \left[\frac{1}{SL}\left(-RI - V_o + V_1\right)\right]$

$\rightarrow$ Solve for I $\rightarrow \quad I = -\frac{R}{SL} I - \frac{1}{SL} V_o + \frac{1}{SL} V_i \quad \rightarrow \quad \left(1 + \frac{R}{SL}\right) I = \frac{1}{SL}\left(V_i - V_o\right)$

$\Rightarrow \quad I = \frac{1}{R + SL}\left(V_i - V_o\right) \quad (2)$

→ Sub I in (1) → $V_o = \frac{1}{sC} \cdot \frac{1}{R + sL} \cdot (V_i - V_o)$

→ Solve for V_o → $V_o = \frac{1}{s^2 LC + RCs + 1} V_i$

→ Siccome $G(s)$ Tra V_i (IN) e V_o (OUT)

$$\frac{V_o}{V_i} = \boxed{G(s) = \frac{1}{s^2 LC + RCs + 1}}$$

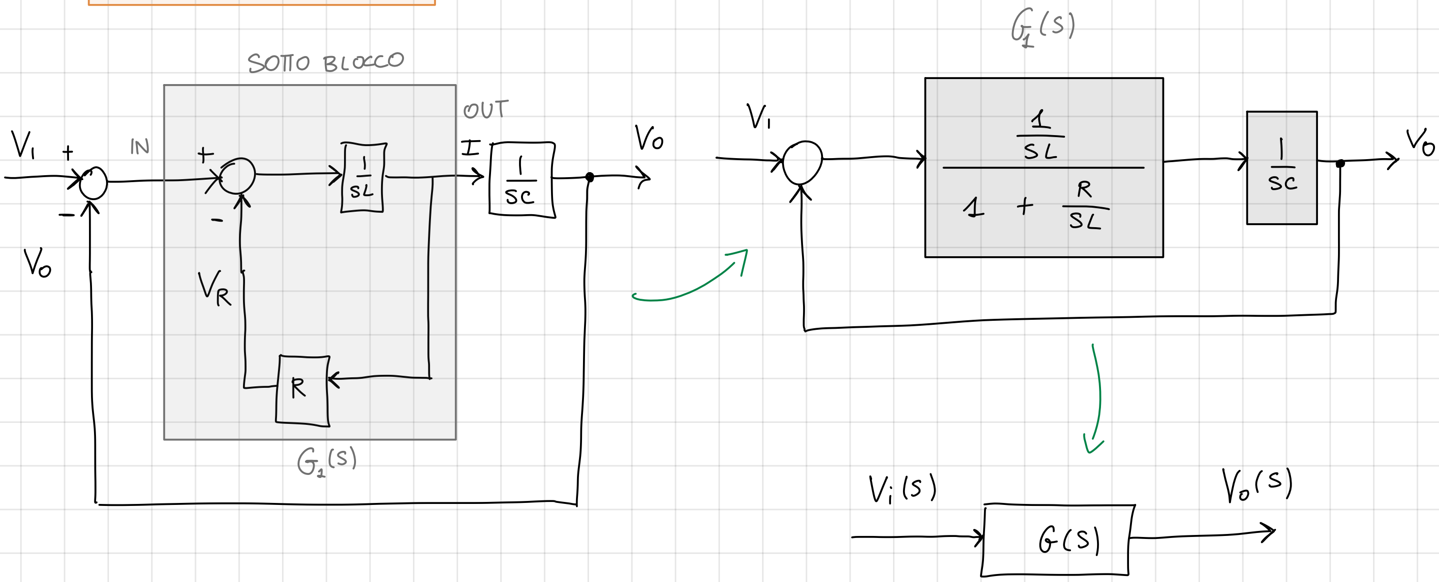
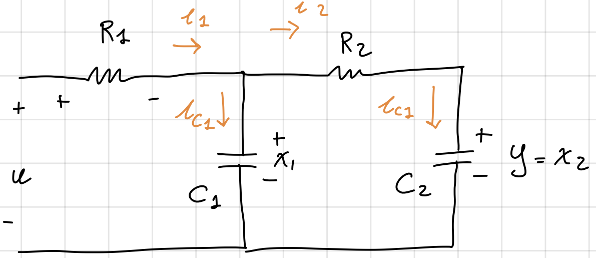
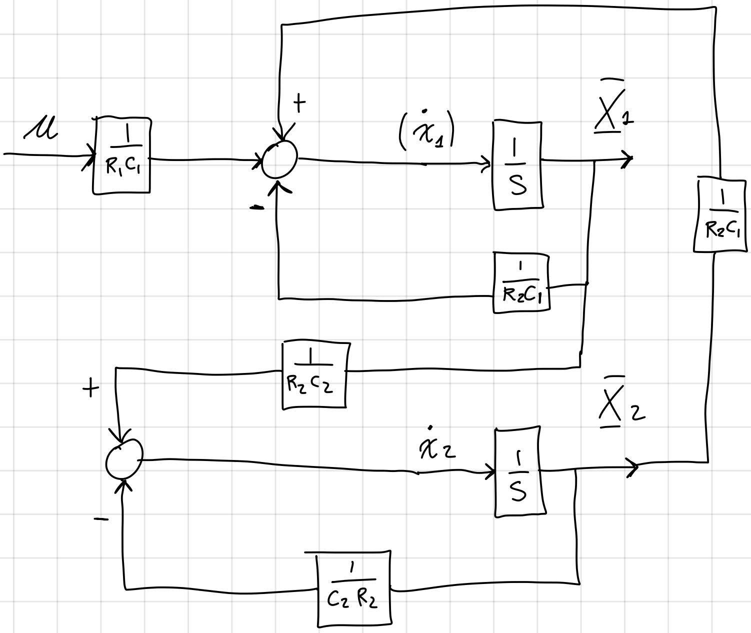


FOTO 2



$$\begin{cases} C_1 \dot{x}_1 = \underbrace{\overbrace{\frac{u - x_1}{R_1}}^{v_{R1}}}_{i_{c1}} - \underbrace{\frac{1}{R_2}(x_1 - x_2)}_{i_{c2}} \\ C_2 \dot{x}_2 = \frac{1}{R_2}(x_1 - x_2) \end{cases} \Rightarrow \begin{cases} \dot{x}_1 = -\frac{1}{C_1}\left(\frac{1}{R_1} \cdot \frac{1}{R_2}\right) x_1 + \frac{1}{R_2 C_1} x_2 + \frac{1}{C_1 R_1} u \\ \dot{x}_2 = \frac{1}{R_2 C_2} x_1 - \frac{1}{C_2 R_2} x_2 \\ y = x_2 \end{cases}$$



Funzione di Trasf x_2 (OUT) e u (IN)

FOTO