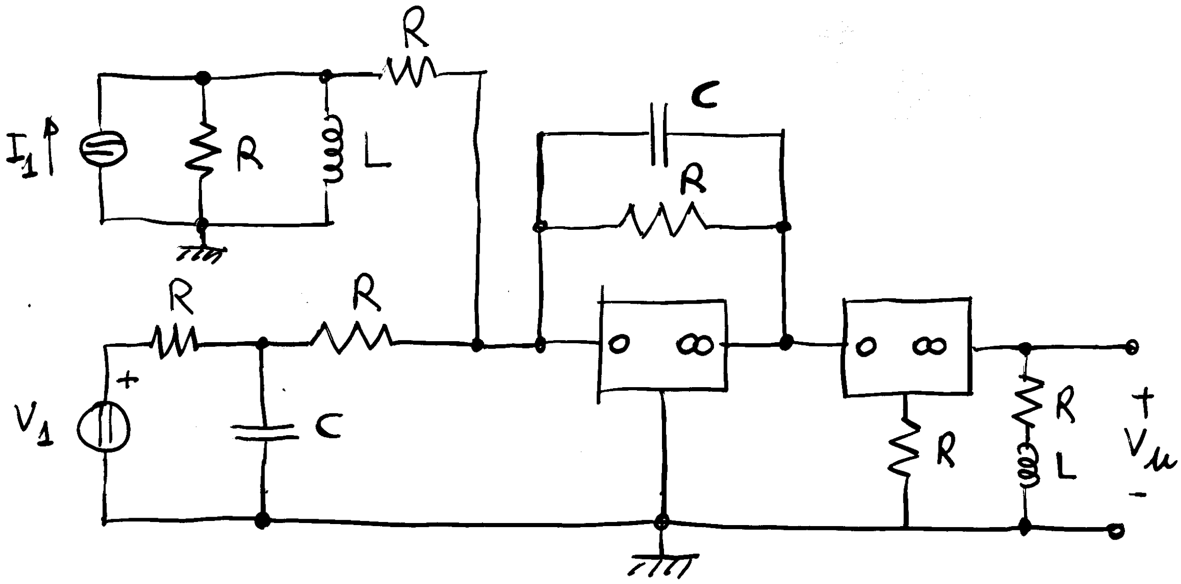
# CORSO DI ELETTROTECNICA Ing. Meccanica V.O. e N.O.

8 Luglio 2002 (tempo ore 1:30)

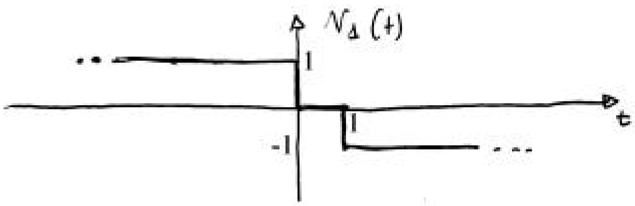
ESERCIZIO




$R$=1; $L$=1; $C$=1; (Ω,H,F)

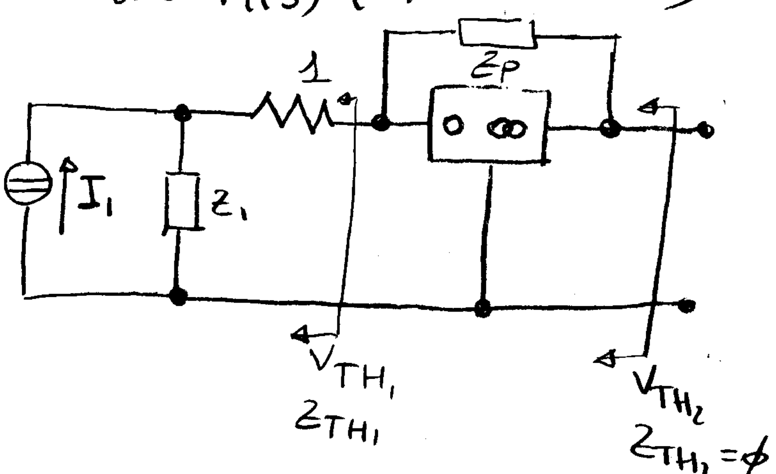
Per il circuito normalizzato in figura determinare:

1. la funzione di rete $F_1(s)= V_u(s)/I_1(s)$; (7p)
2. la funzione di rete $F_2(s)= V_u(s)/V_1(s)$; (7p)
3. il modulo e la fase della $v_u(t)$ per $i_1(t)$=2cos(2$t$) e $v_1(t)$=0; (8p)
4. l'andamento per tutto l'asse dei tempi della $v_u(t)$ quando $v_i(t)$ assume l'andamento in figura ($v_1(t)$=1 per $t$<0; $v_1(t)$=0 per $0 \le t<1$; $v_1(t)$ =-1 per $t$>1 e $i_1(t)$=0) e disegnarlo possibilmente in scala; (8p)



## 1) Calcolo $F_1(s)$ ($V_1$ disattivato)

(1)




$$Z_p = \frac{1}{1+s}$$

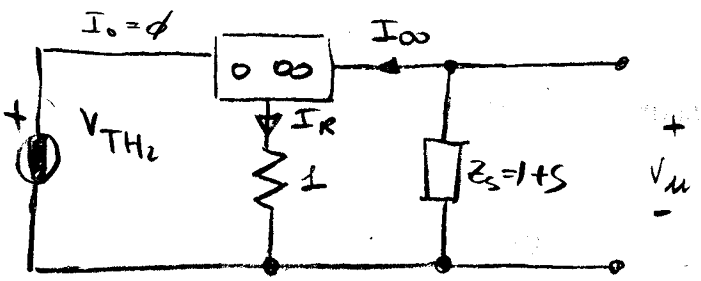
$$Z_1 = \frac{s}{1+s}$$

$$Z_{TH_1} = \frac{1+2s}{1+s}$$

$$V_{TH_1} = I_1 \cdot Z_1 = I_1 \frac{s}{1+s}$$

$$V_{TH_2} = -\frac{Z_P}{Z_{TH_1}} \cdot V_{TH_1} = -\frac{s}{(1+s)(1+2s)} I_1$$

il circuito diventa:



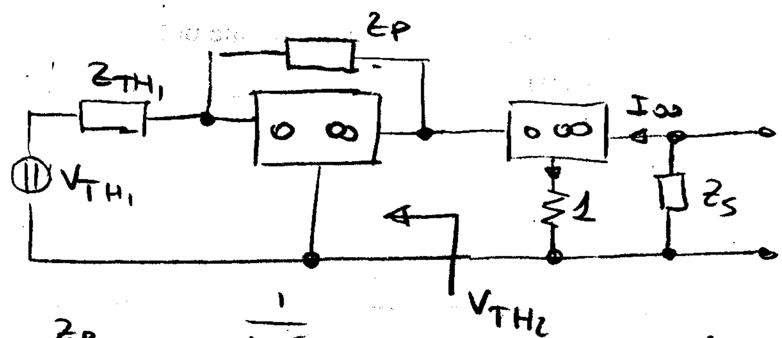

$$I_\infty = I_R \quad (I_0 = \phi)$$

$$I_R = V_{TH_2}/R$$

$$V_u(s) = -I_\infty \cdot Z_s = V_{TH_2} \cdot Z_s \Rightarrow$$

$$V_u(s) = \frac{s}{(\cancel{1+s})(1+2s)} I_1 (\cancel{1+s}) \Rightarrow \boxed{\frac{V_u(s)}{I_1(s)} = \frac{s}{1+2s}}$$

## 2) Calcolo $F_2(s)$ ($I_1$ disattivato)




$$Z_{TH_1} = Z_p + 1 = \frac{2+s}{1+s}$$

$$V_{TH_1} = \frac{V_1}{1+\frac{1}{s}} \cdot \frac{1}{s} = \frac{V_1}{1+s}$$

$$V_{TH_2} = -\frac{Z_P}{Z_{TH_1}} = -\frac{\frac{1}{\cancel{1+s}}}{\frac{2+s}{\cancel{1+s}}} \cdot \frac{V_1}{1+s} = -\frac{V_1}{2(1+\frac{s}{2})(1+s)} \Rightarrow$$

$$V_u(s) = -I_\infty Z_s = V_{TH_2} Z_s = \frac{V_1 (\cancel{1+s})}{2(1+\frac{s}{2})(\cancel{1+s})} \Rightarrow$$

$$\boxed{F_2(s) = \frac{V_u(s)}{V_1(s)} = \frac{1}{2(1+\frac{s}{2})}}$$

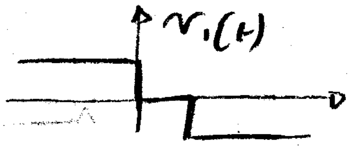
3) Calcolo $v_u(t)$ per $i_1(t) = 2\cos(2t)$.

$\Rightarrow$ Fasori: $\omega = 2$

$$\bar{V}_u = \left.\frac{s}{1+2s}\right|_{s=j2} \cdot 2 = \frac{j4}{1+j4} = \frac{4}{17}(4+j) = \frac{4\sqrt{17}}{17}\, e^{j\,\mathrm{arctg}\left(\frac{1}{4}\right)} \Rightarrow$$

$$v_u(t) = \frac{4}{\sqrt{17}}\cos\left(2t + 1/4\right) \qquad \left(\mathrm{arctg}\left(\tfrac{1}{4}\right) \simeq \tfrac{1}{4}\right)$$

4) Calcolo $v_u(t)$ per $v_1(t) =$




$$v_1(t) = 1 - u_{-1}(t) - u_{-1}(t-1) \Rightarrow$$

sovr. effetti:

- $v_{u_1}(t)$ per $v_1(t) = 1$ (C.C.) $\Rightarrow$ $F_2(s) = \frac{1}{s+2} \Rightarrow \lim_{\omega \to 0} = \frac{1}{2} \Rightarrow$

$$v_{u_1}(t) = \underbrace{\frac{1}{2}} \qquad t < 0$$

- $v_{u_2}(t)$ per $v_1(t) = u_{-1}(t) \Rightarrow$ Laplace

$$V_u(s) = \frac{1}{s}\,\frac{1}{s+2} = \frac{A}{s} + \frac{B}{s+2} = \frac{1}{2s} - \frac{1}{2(s+2)} \Rightarrow$$

$$v_{u_2}(t) = \underbrace{\frac{1}{2}u_{-1}(t) - \frac{1}{2}e^{-t/2}} \qquad t \geq 0$$

- $v_{u_3}(t) \Rightarrow$ T. traslazione $= \underbrace{\frac{1}{2}u_{-1}(t-1) - \frac{1}{2}e^{-\frac{t-1}{2}}} \qquad t \geq 1 \Rightarrow$

$$v_u(t) = v_{u_1}(t) + v_{u_2}(t) - v_{u_3}(t) \Rightarrow$$

$$v_u(t) = \frac{1}{2} - \left[\frac{1}{2} - \frac{1}{2}e^{-\frac{t}{2}}\right]u_{-1}(t) - \left[\frac{1}{2} - \frac{1}{2}e^{-\frac{t-1}{2}}\right]u_{-1}(t-1)$$