PREPARAZIONE AL

1° COMPITINO

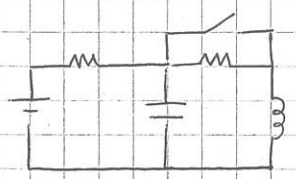
DI

ELETTRONICA

- compitino 9/4/2016
- compitino 1/4/2017
- compitino 7/4/2018
- compitino 30/3/2019
- compitino 2/5/2020
- compitino 17/4/2021
- compitino 23/4/2022
- esercizi vari
- formulari

Compitino 9/4/2016 (nr 4)

3 CIRCUITO + 4 + 5

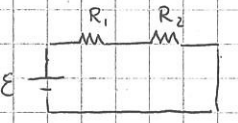


$R_1 = R_2 = R$
$L = 2R^2C$
C e $\mathcal{E}$ noti

Circuito a regime, poi a $t=0$ chiudo interruttore

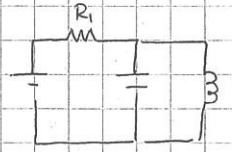
3. Determinare $I_C(0^+)$

A regime: ramo di C = aperto
ramo di L = corto $\rightarrow$ $I_L(0^-) = \ldots = I_L(0^+)$ x continuità



$$I_0 = \frac{\mathcal{E}}{R_1+R_2} = \frac{\mathcal{E}}{2R}$$

A $t=0$: ramo di R_2 = aperto



LKN $I_0(0^+) = I_C(0^+) + I_L(0^+)$

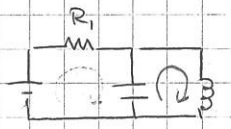
Ricavo $I_C(0^+) = 0$

4. Calcolare $W_{DISSIPATA}(0^+)$

$$|W_{DISS}| = |W_{R1}| = I_0(0^+)^2 \cdot R_1 = \frac{\mathcal{E}^2}{4R^2} \cdot R = \frac{\mathcal{E}^2}{4R}$$

5. Calcolare t a cui I_C è max

$$\begin{cases} \mathcal{E} = R_1 I_0 + \frac{1}{C}\left[\int_0^t I_C(t)\,dt + V_C(0)\right] \\ \frac{1}{C}\left[\int_0^t I_C(t)\,dt + V_C(0)\right] = L\,\dot{I}_L \\ I_0 = I_C + I_L \end{cases}$$



$$\begin{cases} I_0 = \mathcal{E}/R - 1/RC \int_0^t I_C\,dt \\ I_L = \mathcal{E}/R - 1/RC \int_0^t I_C\,dt - I_C \rightarrow \dot{I}_L = -1/RC\, I_C - \dot{I}_C \\ \frac{1}{C}\int_0^t I_C\,dt = \frac{L}{RC} I_C - L\,\dot{I}_C \rightarrow \frac{1}{C} I_C = \frac{L}{RC}\dot{I}_C - L\,\ddot{I}_C \end{cases}$$

$$\ddot{I}_C + \frac{\dot{I}_C}{RC} + \frac{I_C}{LC} = 0$$

eq. secolare $\lambda = -\frac{1}{2RC} \pm \sqrt{\frac{1}{4R^2C^2} - \frac{1}{2R^2C^2}} = -\frac{1}{2RC}(1 \pm j)$

$$\begin{cases} I_C(t) = e^{-\frac{t}{2RC}}\left(A_1 \cos\left(\frac{t}{2RC}\right) + A_2 \sin\left(\frac{t}{2RC}\right)\right) \\ I_C(0) = 0 \end{cases}$$

Non importa avere un'altra C.I. perché a me interessa studiare solo la derivata prima:

$$I_c(0) = 0 \iff 0 = A_1$$

$$\dot{I}_c(t) = \frac{d}{dt}\left[e^{-\frac{t}{2RC}} A_2 \sin\frac{t}{2RC} \right] =$$

$$= \left[-\frac{1}{2RC} \sin\left(\frac{t}{2RC}\right) + \frac{1}{2RC} \cos\left(\frac{t}{2RC}\right) \right] A_2 \, e^{-t/2RC}$$

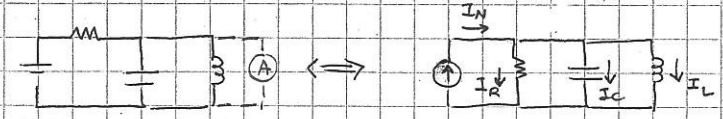
$$\dot{I}_c(t) = 0 \iff -\sin\alpha + \cos\alpha = 0$$

$$\tan\alpha = 1$$

$$\alpha = \frac{\pi}{4} + k\pi$$

Trovo la soluzione ponendo $k=0$, ovvero $\frac{t}{2RC} = \frac{\pi}{4} \rightarrow t = RC\frac{\pi}{2}$

POSSO SEMPLIFICARE IL CIRCUITO? Provo a usare Norton:



$$R_N = R \qquad I_N = \frac{\mathcal{E}}{R}$$

Adesso è un circuito RLC serie, per cui so che

$$I_L(t) = I_N + e^{-t/2RC}\left[a_1 \cos\frac{t}{2RC} + a_2 \sin\frac{t}{2RC} \right]$$

poiché $\ddot{I}_L + \frac{1}{RC}\dot{I}_L + \frac{1}{LC} I_L = \frac{I_N}{LC}$

$$\lambda = -\frac{1}{2RC} \pm \sqrt{\frac{1}{4R^2C^2} - \frac{1}{2R^2C^2}} = -\frac{1}{2RC}(1 \pm j)$$

USO LKN $I_N = I_R + I_C + I_L$

con $I_R = \frac{V_R}{R}$ e $V_R = V_{gen} =$

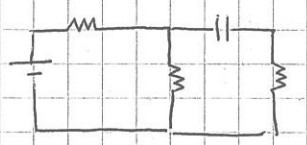
USO LKN del circuito precedente $I_0 = I_C + I_L$

$$I_C = I_0 - I_L = \frac{\mathcal{E}}{2R} - \frac{\mathcal{E}}{R} - e^{-t/2RC}(\text{ecc})$$

$$I_C(0) = 0 \iff \frac{\mathcal{E}}{2} = A_1$$

c'è qualcosa che non va!

6 CIRCUITO + 7 +



$R_1 = R_2 = R_3 = R$
$\mathcal{E}, C, R$ noti

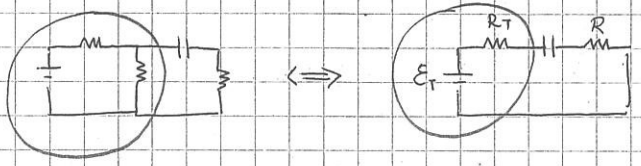
$Q(0) = 0$

6. Calcolare l'energia immagazzinata da C a regime.

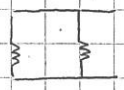
Poiché $Q(0) = 0$, $V_c(0) = 0$

$\Delta U_c = 1/2 \; C \; V_c^2(\infty)$

Uso Thevenin:

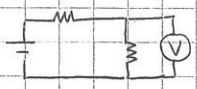


R_T:



$R_T = R_1 R_2 \,//\, = \dfrac{R_1 R_2}{R_1 + R_2} = \dfrac{R}{2}$

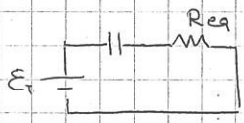
$\mathcal{E}_T$:



PARTITORE DI TENSIONE

$\mathcal{E}_T = \dfrac{R_2}{R_1 + R_2}\,\mathcal{E} = \dfrac{\mathcal{E}}{2}$

Ricavo il circuito RC serie:



$R_{eq} = R_3 R_T$ serie $= \dfrac{3}{2}R$

$$\begin{cases} V_c(t) = \mathcal{E}_T + A\, e^{-t/R_{eq}C} \\ V_c(0) = 0 \end{cases}$$

$A = -\mathcal{E}/2$

$V_c(t) = \dfrac{\mathcal{E}}{2}\left(1 - e^{-t/R_{eq}C}\right) \longrightarrow \dfrac{\mathcal{E}}{2}$

$\Delta U_c = 1/2 \; C \; \mathcal{E}^2/4 = \dfrac{C\mathcal{E}^2}{8} = 1{,}35 \cdot 10^{-3}\ \text{J}$

7. Calcolare $\bar{t}$ per avere $\text{d.d.p} = \left(1 - \frac{1}{e}\right) V_c(\infty)$

$\dfrac{\mathcal{E}}{2}\left(1 - e^{-\bar{t}/R_{eq}C}\right) = \left(1 - \dfrac{1}{e}\right) V_c(\infty) \Rightarrow$

$\dfrac{\bar{t}}{R_{eq}C} = 1$, ovvero $\bar{t} = \dfrac{3}{2}RC = 94{,}7\ \text{ms}$