Compito di Elettrotecnica

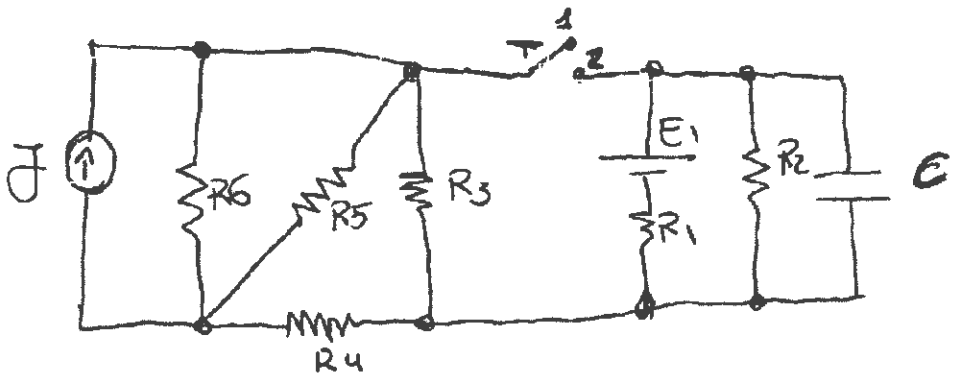
8 Giugno 2022

Nome e Cognome .....**Matricola**.....

Corso di Laurea.....

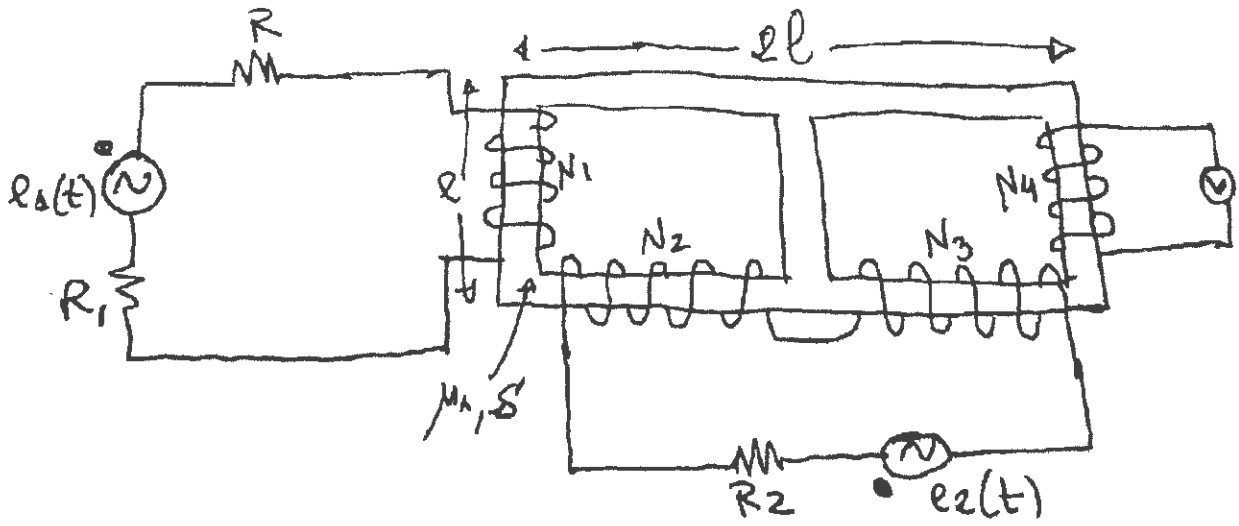
ES.1–Il sistema si trova a regime. Il tasto T all'istante t=0 si chiude, determinare l'espressione temporale della tensione che insiste ai capi di C e la potenza generata e erogata dal generatore di tensione reale E1-R1.

E_1 = 5V; J = 3A; R_1= 5 Ω; R_2=R_4=R_6=3 Ω; R_3= R_5 = 4 Ω; C=1mF

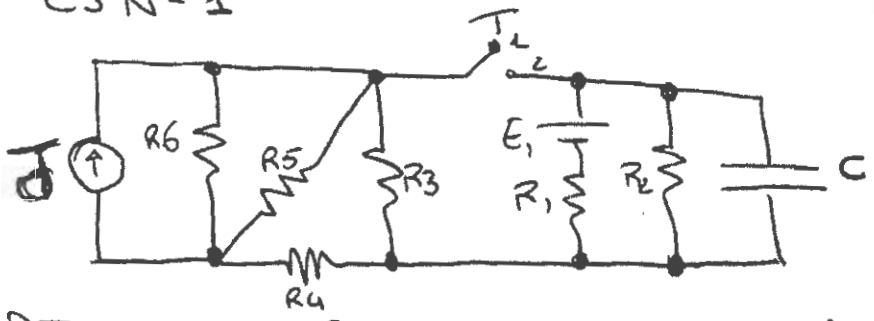


ES.2 – Dato il circuito in figura, determinare il valore della tensione misurata dal voltmetro ideale e i valori di tutte le correnti che interessano il circuito.

$e_1(t) = \sin\left(wt + \frac{\pi}{3}\right)$ V ; $e_2(t) = \sin\left(wt + \frac{\pi}{2}\right)$ V; f=50Hz; R_1=R_2=5Ω; R=3Ω; l=0.3cm; S= 0.6cm^2; μ_r=800; N_1=80; N_2=100; N_3=100; N_4=120



ES N° 1



Determinare l'espressione temporale della tensione di uscita ai capi di C.

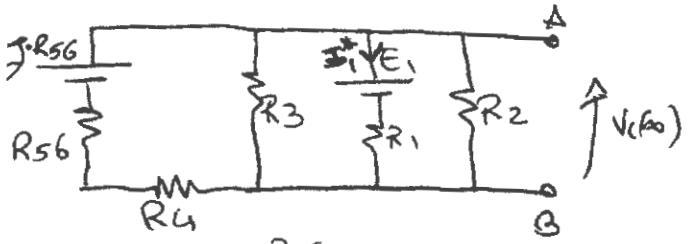
$$v_c(t) = v_c(0)e^{-t/\tau} + v_c(\infty)\left(1 - e^{-t/\tau}\right)$$

- $v_c(0) \Rightarrow$ T aperto $\quad C \Rightarrow$ c.a.

$$I_1 = \frac{E_1}{R_1 + R_2}$$

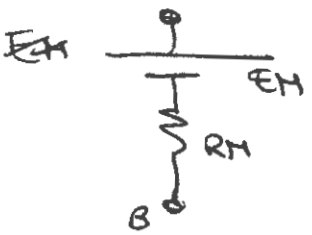
$$v_c(0) = I_1 R_2$$

- $v_c(\infty) \Rightarrow$ T chiuso $\quad C \Rightarrow$ c.a.



$$R_{56} = R_5 // R_6$$

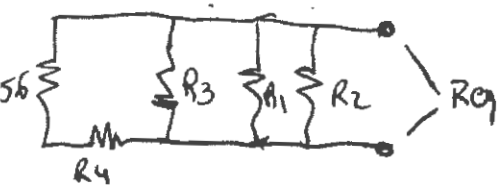
Applico Millman tra tutti i rami:



$$E_H = \frac{\frac{J \cdot R_{56}}{(R_{56}+R_4)} + \frac{E_1}{R_1}}{\frac{1}{R_{56}+R_4} + \frac{1}{R_3} + \frac{1}{R_1} + \frac{1}{R_2}}$$

$$v_c(\infty) = E_H$$

- $\tau = R_{eq} C$



$$R_{eq} = \left\{\left[(R_{56}+R_4) // R_3\right] // R_1\right\} // R_2$$

NOTA $V_{AB} = E_H \Rightarrow$ mi calcolo la I_1^*:

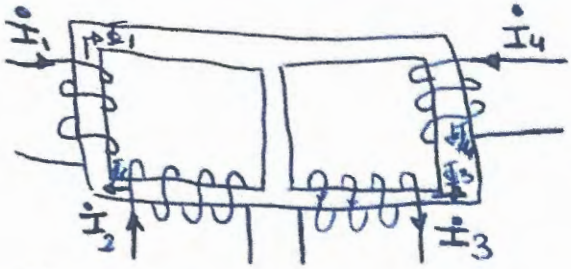
$$V_{AB} = E_1 + R_1 I_1^* \Rightarrow I_1^* = \frac{V_{AB} - E_1}{R_1}$$

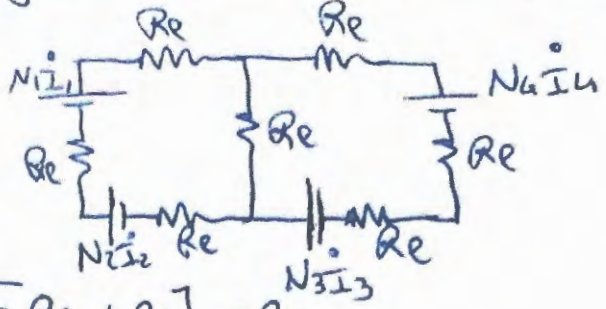
$P_{gen\,E_1 R_1} = E_1 \cdot I_1^*$

$P_{erog\,E_1 R_1} = V_{AB} \cdot I_1^*$

ES. N° 2

Consideriamo il circuito magnetico e il cir. elettrico equivalente:





$$\mathcal{R}_{eq1} = \mathcal{R}_{eq2} = \mathcal{R}_{eq3} = \mathcal{R}_{eq4} = \mathcal{R}_{eq} = [3\mathcal{R}_e // \mathcal{R}_e] + 3\mathcal{R}_e$$

dove: $\mathcal{R}_e = \frac{l}{\mu_1 S}$

$$L_1 = \frac{N_1^2}{\mathcal{R}_{eq}} \qquad L_2 = \frac{N_2^2}{\mathcal{R}_{eq}} \qquad L_3 = \frac{N_3^2}{\mathcal{R}_{eq}}$$

Calcoliamo i coeff di mutua:

$M_{12} = M_{21}$ (>0)

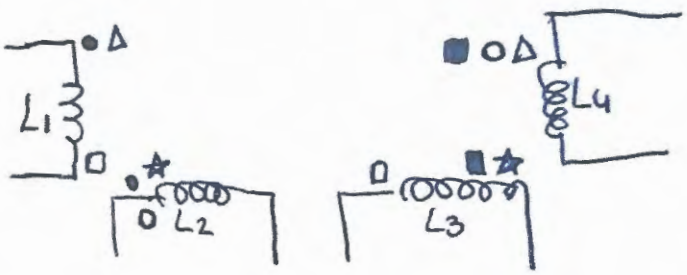
$M_{14} = M_{41}$ (>0)

$M_{13} = M_{31}$ (<0)

$M_{23} = M_{32}$ (<0)

$M_{24} = M_{42}$ (>0)

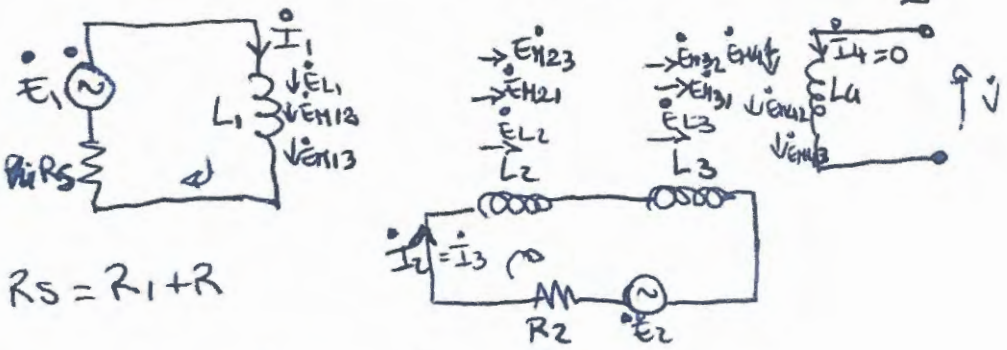
$M_{34} = M_{43}$ (<0) * x il calcolo ved. pag. seguente



Il voltmetro essendo ideale si comporta da c. a. $\Rightarrow \dot{I}_4 = 0$

$e_1(t) = \text{sen}\left(\omega t + \frac{\pi}{3}\right) \Rightarrow \dot{E}_1 = \frac{\sqrt{2}}{2}\left(\frac{1}{2} + j\frac{\sqrt{3}}{2}\right)$

$e_2(t) = \text{sen}\left(\omega t + \frac{\pi}{2}\right) \Rightarrow \dot{E}_2 = j\frac{\sqrt{2}}{2}$



$R_S = R_1 + R$

$$\begin{cases} \dot{E}_1 + \dot{E}_{L1} + \dot{E}_{M12} + \dot{E}_{M13} = \dot{I}_1 R_S \\ \dot{E}_2 + \dot{E}_{L2} + \dot{E}_{L3} + \dot{E}_{M21} + \dot{E}_{M23} + \dot{E}_{M31} + \dot{E}_{M32} = \dot{I}_2 R_2 \\ \dot{V} + \dot{E}_{M41} + \dot{E}_{M42} + \dot{E}_{M43} = 0 \end{cases}$$

$$\begin{cases} \dot{E}_1 - j\omega L_1 \dot{I}_1 - j\omega M_{12} \dot{I}_2 + j\omega M_{13} \dot{I}_2 = \dot{I}_1 R_S \\ \dot{E}_2 - j\omega L_2 \dot{I}_2 - j\omega L_3 \dot{I}_3 - j\omega M_{21} \dot{I}_1 + j\omega M_{23} \dot{I}_2 + j\omega M_{31} \dot{I}_1 + j\omega M_{32} \dot{I}_2 \\ \dot{V} - j\omega M_{41} \dot{I}_1 - j\omega M_{42} \dot{I}_2 + j\omega M_{43} \dot{I}_2 = 0 \end{cases}$$

$\dot{I}_2 R_2$

Dalle prime due equazioni mi calcolo il valore delle correnti $\dot{I}_1$ e $\dot{I}_2$.

$\Rightarrow \dot{I}_3 = \dot{I}_2$ e $\dot{I}_4 = 0$

Dalla 3 eq. mi calcolo il valore efficace di $\dot{V}$

* Calcolo dei coeff. di mutua-induzione:

$$M_{42} = M_{24} = \frac{N_4 N_2}{R_{eq4}} \cdot \alpha_{42} = \frac{N_4 N_2}{R_{eq}} \cdot \frac{R_e}{3R_e + R_e} = \frac{N_4 N_2}{R_{eq}} \cdot \frac{1}{4}$$

$$M_{14} = M_{41} = \frac{N_1 N_4}{R_{eq1}} \cdot \alpha_{14} = \frac{N_1 N_4}{R_{eq}} \cdot \frac{R_e}{3R_e + R_e} = \frac{N_1 N_4}{R_{eq}} \cdot \frac{1}{4}$$

$$M_{13} = M_{31} = \frac{N_1 N_3}{R_{eq1}} \cdot \alpha_{13} = \frac{N_1 N_3}{R_{eq}} \cdot \frac{R_e}{3R_e + R_e} = \frac{N_1 N_3}{R_{eq}} \cdot \frac{1}{4}$$

$$M_{23} = M_{32} = \frac{N_2 N_3}{R_{eq2}} \cdot \alpha_{23} = \frac{N_2 N_3}{R_{eq}} \cdot \frac{R_e}{3R_e + R_e} = \frac{N_2 N_3}{R_{eq}} \cdot \frac{1}{4}$$

$$M_{12} = M_{21} = \sqrt{L_1 L_2}$$

$$M_{34} = M_{43} = \sqrt{L_3 L_4}$$