Compito di Elettrotecnica

13 Settembre 2021

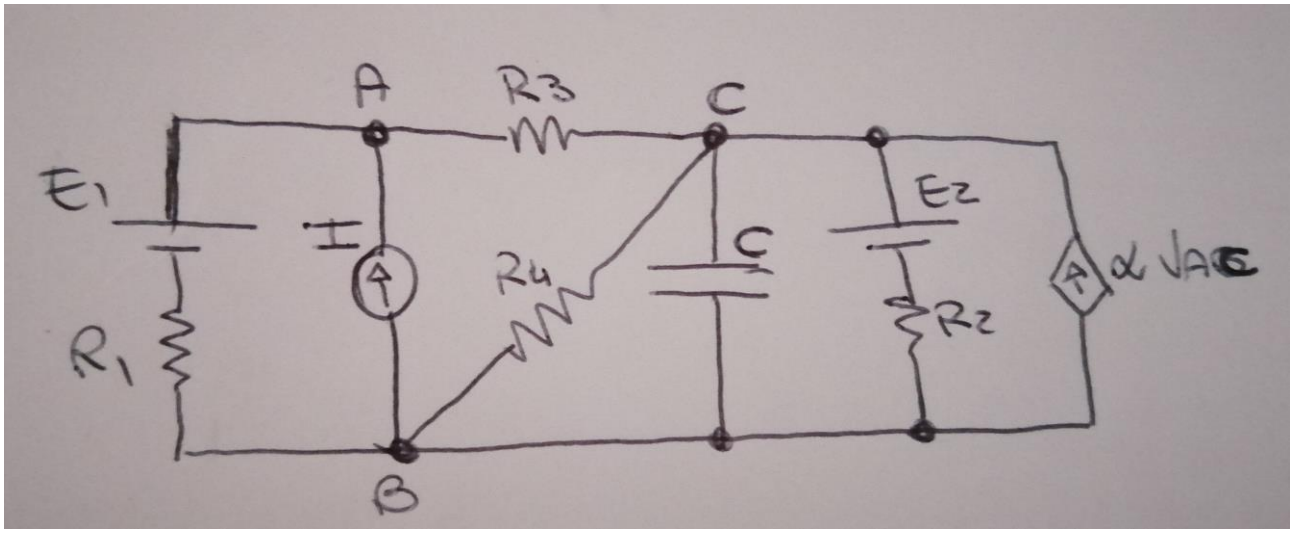
Nome e Cognome ……

Matricola……

Corso di Laurea……

ES.1 – Il sistema si trova a regime. Determinare l'energia immagazzinata dal condensatore C.

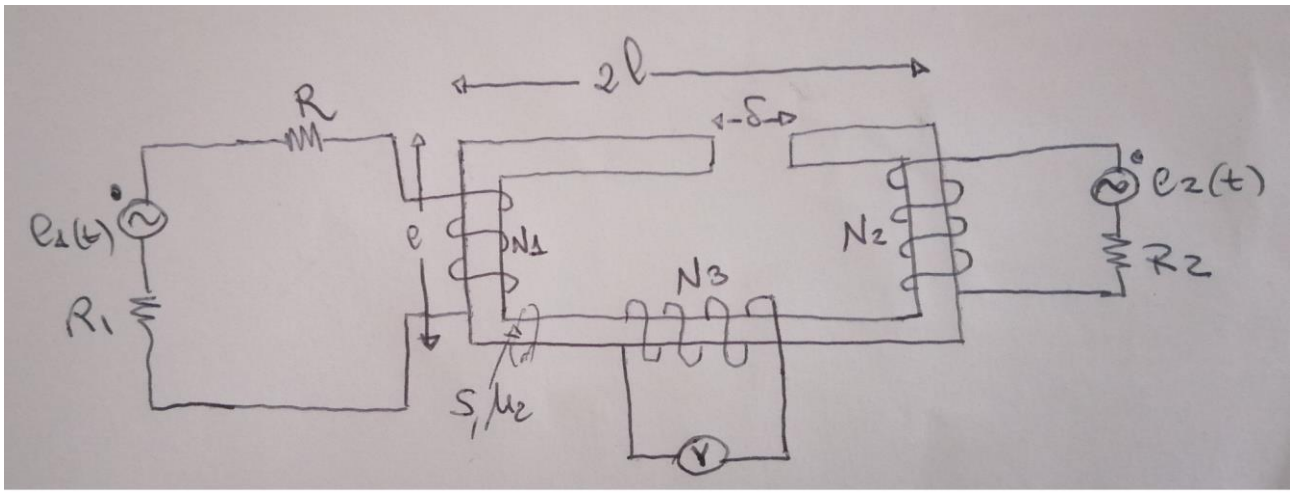
E1 = 5V; E2=4V; R_1= R_3= 2Ω; R_2=R_4=5 Ω; I=2A ; α=3 Ω^{-1}; C=1mF



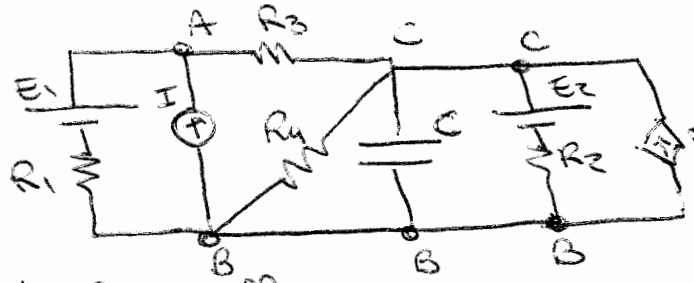
ES.2– Dato il circuito in figura, determinare il numero di spire N_3 affinché il voltmetro ideale misuri una tensione di 2V.

$e_1(t) = 2\sqrt{2}\ \sin\left(wt + \frac{\pi}{6}\right) V$; $e_2(t) = 4\sqrt{2}\ \sin\left(wt + \frac{\pi}{4}\right) V$; ω=100 rad/sec;

R_1 =5 Ω; R_2 =R= 5 Ω; N_1= 100; N_2 = 80; l=4cm; S=2cm^2; δ=0.5cm; μ_r =1000

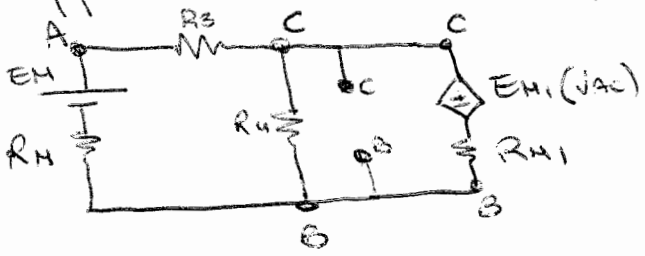


ES. N° 1



$$E_C = \frac{1}{2} C V_{CB}^2$$

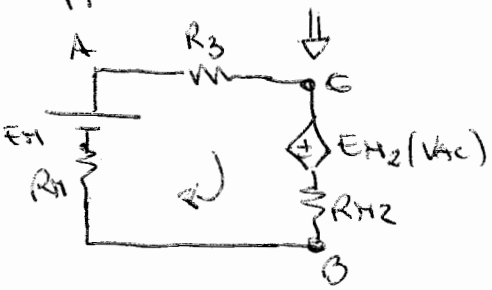
Applico Millman Tra A-B e C-B:



$$E_H = \frac{\frac{E_1}{R_1} + I}{\frac{1}{R_1}}$$

$$R_H = R_1$$

Applico Millman Tra C-B.



$$E_{H1}(V_{AC}) = \frac{\frac{E_2}{R_2} + \alpha V_{AC}}{\frac{1}{R_2}}$$

$$R_{H1} = R_2$$

$$E_{H2} = \frac{\frac{E_{H1}(V_{AC})}{R_{H1}}}{\frac{1}{R_{H1}} + \frac{1}{R_4}}$$

$$R_{H2} = \frac{1}{\frac{1}{R_{H1}} + \frac{1}{R_4}}$$

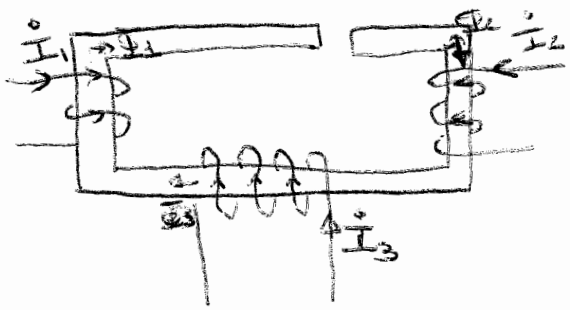
Legge alle maglie:

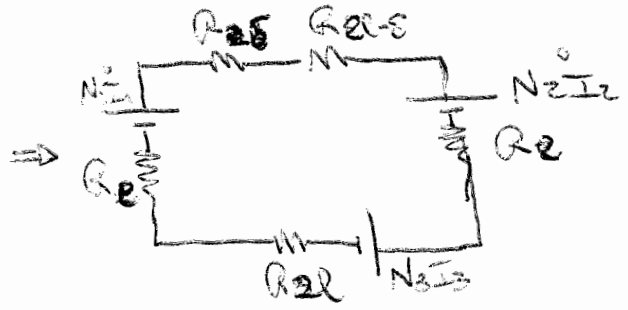
$$\begin{cases} I^* = \dfrac{E_H - E_{H2}(V_{AC})}{R_H + R_3 + R_{H2}} \\ V_{AC} = I^* R_3 \end{cases} \Rightarrow I^*$$

Noto I^* mi calcolo V_{CB}: $V_{CB} - E_{H2}(V_{AC}) = I^* R_{H2}$

$$\boxed{E_C = \frac{1}{2} C V_{CB}^2}$$

ES. N=2





$$R_e = \frac{l}{\mu_0 \mu_{r2} S'} \qquad R_{2e-\delta} = \frac{(2l-\delta)}{\mu_0 \mu_{r2} S} \qquad R_\delta = \frac{\delta}{\mu_0 S}$$

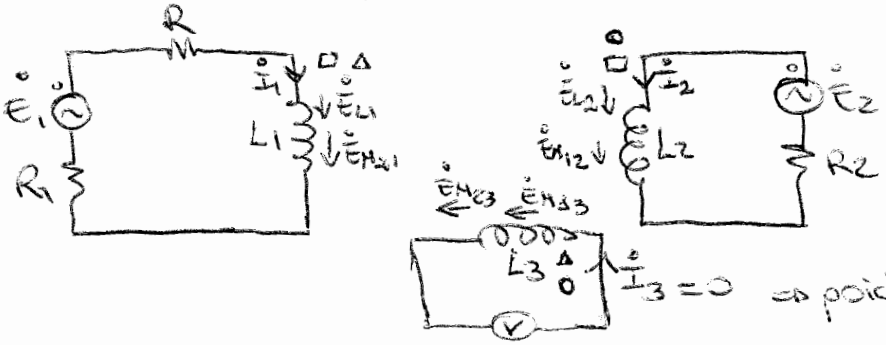
$$e_1(t) = 2\sqrt{2}\,\sin\left(\omega t + \frac{\pi}{6}\right) \Rightarrow \dot{E}_1 = 2\left(\cos\frac{\pi}{6} + j\sin\frac{\pi}{6}\right)$$

$$e_2(t) = 4\sqrt{2}\,\sin\left(\omega t + \frac{\pi}{4}\right) \Rightarrow \dot{E}_2 = 4\left(\cos\frac{\pi}{4} + j\sin\frac{\pi}{4}\right)$$

$$R_{eq1} = R_{eq2} = R_{eq3} = R_{eq} = 2R_e + R_{2l} + R_{(2e-\delta)} + R_\delta$$

$$L_1 = \frac{N_1^2}{R_{eq}} \qquad L_2 = \frac{N_2^2}{R_{eq}}$$

$$M_{12} = M_{21} = \sqrt{L_1 L_2} > 0$$



$\dot{I}_3 = 0 \Rightarrow$ poiché il voltmetro si comporta come c.a.

$$\begin{cases} \dot{E}_1 + \dot{E}_{L1} + \dot{E}_{M21} = \dot{I}_1 (R_1 + R) \\ \dot{E}_2 + \dot{E}_{L2} + \dot{E}_{M12} = \dot{I}_2 R_2 \\ \dot{V} + \dot{E}_{M23} + \dot{E}_{M13} = 0 \end{cases} \Rightarrow \begin{cases} \dot{E}_1 - j\omega L_1 \dot{I}_1 - j\omega M_{21} \dot{I}_2 = \dot{I}_1 (R_1 + R) \\ \dot{E}_2 - j\omega L_2 \dot{I}_2 = j\omega M_{12} \dot{I}_1 - \dot{I}_2 R_2 \\ 0 = j\omega M_{23} \dot{I}_2 + j\omega M_{13} \dot{I}_1 \end{cases}$$

dalle prime 2 equaz. del sistema mi ricavo $\dot{I}_1$ e $\dot{I}_2$.

Sapendo che:

$$M_{13} = \sqrt{L_1 L_3} = \sqrt{\frac{N_1^2}{R_{eq}} \cdot \frac{N_3^2}{R_{eq}}} = \frac{N_1 N_3}{R_{eq}}$$

$$M_{23} = \sqrt{L_2 L_3} = \sqrt{\frac{N_2^2}{R_{eq}} \cdot \frac{N_3^2}{R_{eq}}} = \frac{N_2 N_3}{R_{eq}}$$

Sostituendo nella 3equazione e sapendo che il voltmetro misura valori efficaci:

$$2 = \omega \frac{N_3}{R_{eq}} \left(|N_1 \dot{I}_1 + N_2 \dot{I}_2|\right) \Rightarrow N_3 = \frac{2 R_{eq}}{\omega \left|N_1 \dot{I}_1 + N_2 \dot{I}_2\right|}$$