Compito di Elettrotecnica

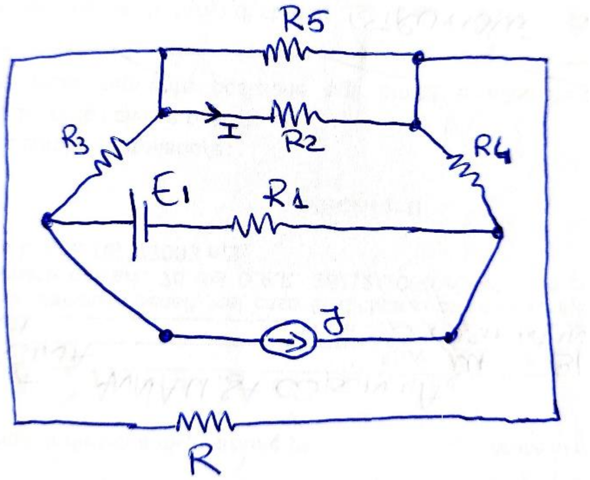
1 Febbraio 2023

Nome e Cognome ……………………………………………………………Matricola……………………

Corso di Laurea………………………………………………………………………………………………….

ES.1–Il sistema si trova a regime. Determinare il valore della corrente **I** che scorre su R_2 applicando il teorema di Thevenin.

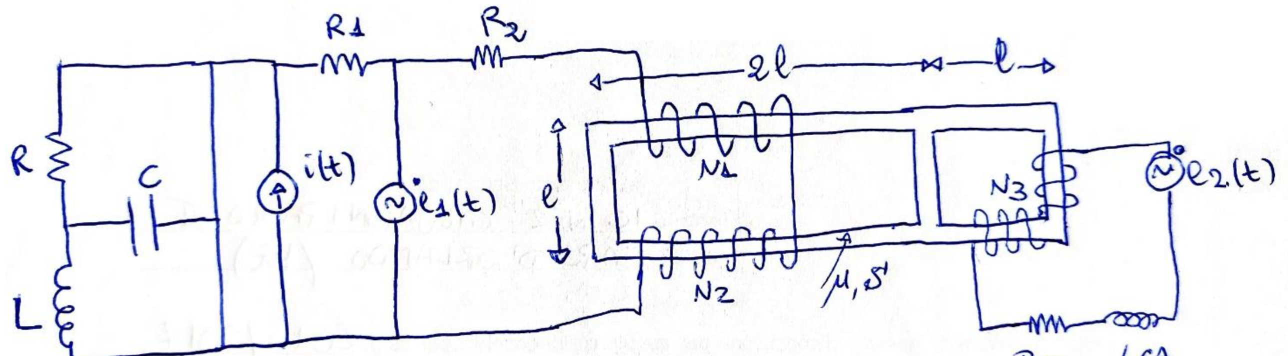
E_1 = 5V; J = 3A; R=2 Ω; R_1=10 Ω; R_2=5 Ω; R_3= R_5=3 Ω; R_4=4 Ω



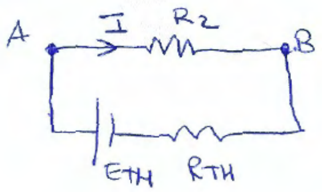
ES.2 – Dato il circuito in figura a regime, determinare le espressioni temporali delle correnti che interessano ogni avvolgimento presente nel circuito e determinare inoltre la potenza attiva e reattiva sul carico R_{CA}-L_{CA}

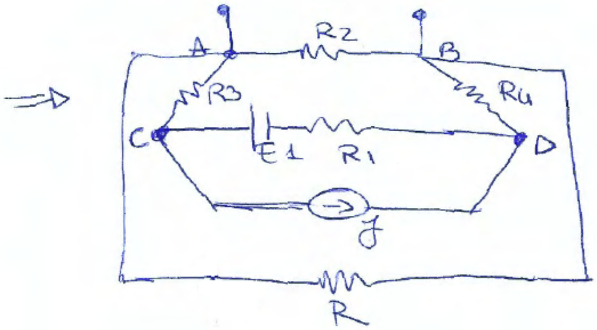
$$\boldsymbol{i(t) = 2\sqrt{2}\sin\left(wt + \frac{\pi}{2}\right)A;\ e_1(t) = 3\sqrt{3}\sin(wt + \frac{\pi}{3})V; e_2(t) = 2\ \sin(wt - \frac{\pi}{4})\,V;}$$

R= 3Ω; C =2mF; L= 0.5mH; R_1 = 1Ω; R_2=2Ω; R_{CA}=6 Ω; L_{CA}=3mH; f = 50Hz; N_1=100; N_2=200; N_3=300; l=0.3cm; S=0.3cm²; μ_r=800;



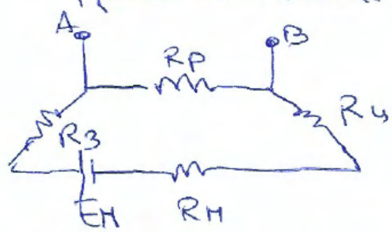
E.S. N° 1





$E_{TH} = V_{AB}(0)$

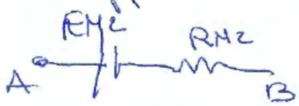
Applico Millmann tra C-D e faccio il parallelo tra R_2 e R:



$$E_M = \frac{\frac{E_1}{R_1} - J}{\frac{1}{R_1}} = -25\,V$$

$$R_M = R_1$$

Riapplico Millmann:



$$E_{M2} = \frac{\frac{E_M}{R_M+R_3+R_4}}{\frac{1}{R_M+R_3+R_4} + \frac{1}{R_P}} = -1.648\,V$$

$$R_{M2} = \frac{1}{\frac{1}{R_M+R_3+R_4} + \frac{1}{R_P}} = 1.12\,\Omega$$

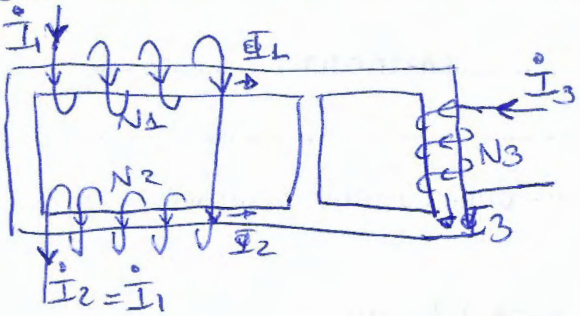
$R_{TH} = R_{M2} = 1.12\,\Omega \Rightarrow V_{AB}(0) = E_{M2}$

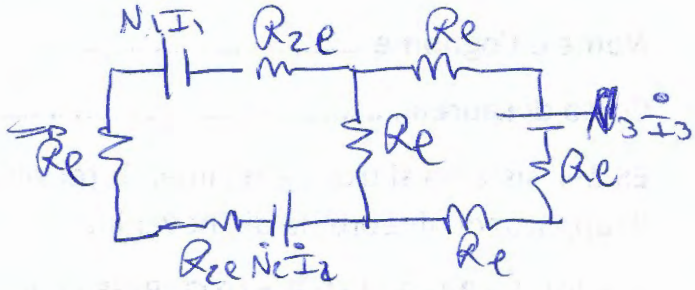
$$I = \frac{E_{TH}}{R_{TH}+R_2} = -0.269\,A$$

ES. N° 2

Nel circuito è presente un generatore di tensione prevalente ($e_1(t)$) dunque TUTTO quello che è presente alla sinistra del generatore si può trascurare.

Consideriamo il nucleo magnetico:





$$R_{eq1} = (3Re \,//\, Re) + Re + 2R_{2e} = \frac{23}{4} Re$$

$$R_{eq2} = R_{eq1}$$

$$R_{eq3} = (2R_{2e} + Re) \,//\, Re + 3Re = \frac{23}{6} Re$$

$$\alpha_{12} = 1 \qquad \alpha_{13} = \frac{Re}{Re + 3Re} = \frac{1}{4} \qquad \alpha_{23} = \frac{1}{4}$$

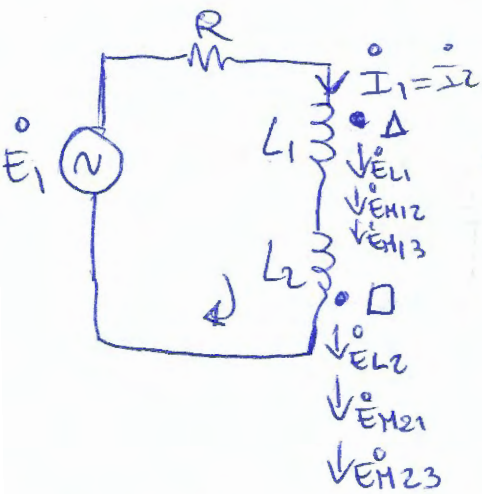
$$L_1 = \frac{N_1^2}{R_{eq1}} \qquad L_2 = \frac{N_2^2}{R_{eq2}} \qquad L_3 = \frac{N_3^2}{R_{ep3}}$$

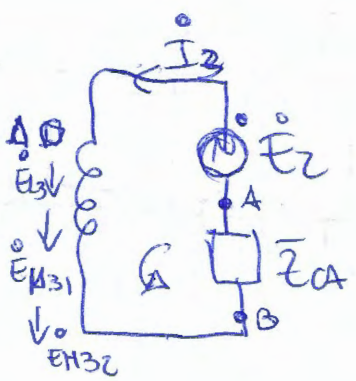
$$M_{13} = \alpha_{13} \frac{N_1 N_3}{R_{eq3}} = M_{31} \ (>0)$$

$M_{12} = \sqrt{L_1 L_2} = M_{21}$ in quanto acc. perfetto (<0)

$$M_{23} = \alpha_{23} \frac{N_2 N_3}{R_{ep3}} = M_{32} \ (<0)$$

$$\bar{Z}_{CA} = R_{CA} + j\omega L_{CA}$$





$$\begin{cases} \dot{E}_1 + \dot{E}_{L1} + \dot{E}_{M12} + \dot{E}_{M13} + \dot{E}_{L2} + \dot{E}_{M21} + \dot{E}_{M23} = \dot{I}_1 R \\ \dot{E}_2 + \dot{E}_{L3} + \dot{E}_{M31} + \dot{E}_{M32} = \dot{I}_3 \bar{Z}_{CA} \end{cases}$$

$$e_1(t) = 3\sqrt{3}\,\text{sen}\left(\omega t + \frac{\pi}{3}\right) \Rightarrow \dot{E}_1 = \frac{3\sqrt{3}}{\sqrt{2}}\left(\cos\frac{\pi}{3} + j\,\text{sen}\frac{\pi}{3}\right) = 1{,}84 + j3.18 \ V$$

$$e_2(t) = 2\,\text{sen}\left(\omega t - \frac{\pi}{4}\right) \Rightarrow \dot{E}_2 = \sqrt{2}\left(\cos\left(-\frac{\pi}{4}\right) + j\,\text{sen}\left(-\frac{\pi}{4}\right)\right) = 1 - j \ V$$

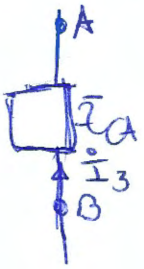
$$\begin{cases} \dot{E} - j\omega L_1 \dot{I}_1 + j\omega M_{12} \dot{I}_1 - j\omega M_{13} \dot{I}_3 - j\omega L_2 \dot{I}_1 + j\omega M_{21} \dot{I}_1 + \\ \quad + j\omega M_{23} \dot{I}_3 = \dot{I}_1 R \\ \dot{E}_2 - j\omega L_3 \dot{I}_3 - j\omega M_{31} \dot{I}_1 + j\omega M_{32} \dot{I}_1 = \dot{I}_3 \bar{Z}_{CA} \end{cases}$$

Da questo sistema mi calcolo $\dot{I}_1$ e $\dot{I}_3 \Rightarrow$

$$i_1(t) = \sqrt{2}\, |\dot{I}_1| \, \text{sen}(\omega t + \arg\{\dot{I}_1\})$$

$$i_3(t) = \sqrt{2}\, |\dot{I}_3| \, \text{sen}(\omega t + \arg\{\dot{I}_3\})$$

Inoltre veniva richiesto di calcolare la pot. attiva e reattiva su $\bar{Z}_{CA}$:



$$\bar{S}_{AB} = \dot{V}_{AB} \cdot \overset{\vee}{I}_3 = \left(-\dot{I}_3 \bar{Z}_{CA}\right) \overset{\vee}{I}_3 = P_{CA} + jQ_{CA}$$