

Compito di Elettrotecnica

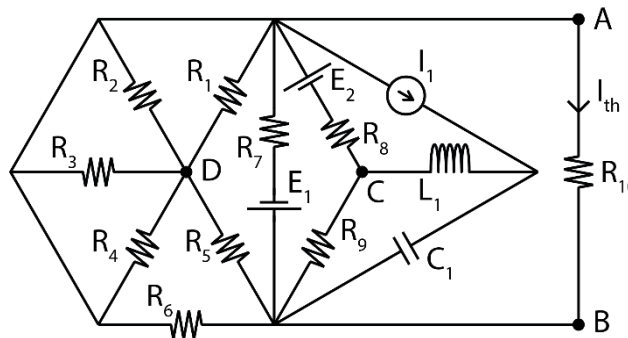
15 Febbraio 2024

Nome e Cognome Matricola.....

Corso di Laurea.....

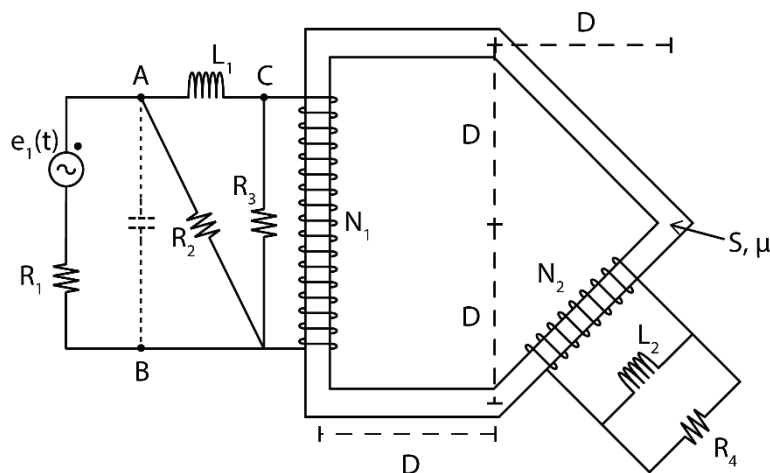
ES.1 – Dato il circuito in figura a regime, determinare il valore della corrente I_{th} applicando il teorema di Thevenin. Inoltre, calcolare l'energia immagazzinata nell'induttore L_1 .

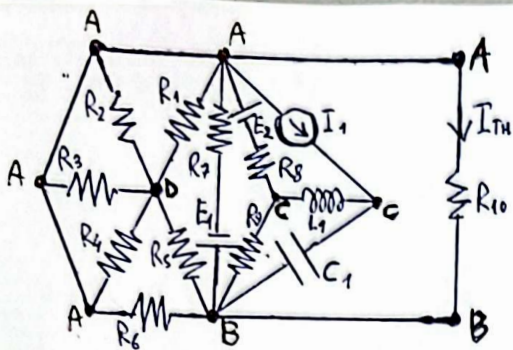
- $E_1 = 5 \text{ V}; \quad E_2 = 3 \text{ V}; \quad I_1 = 2 \text{ A}; \quad L_1 = 5 \text{ mH}; \quad C_1 = 5 \mu\text{F};$
 $R_1 = 6 \Omega; \quad R_2 = 4 \Omega; \quad R_3 = 9 \Omega; \quad R_4 = 7 \Omega; \quad R_5 = 5 \Omega;$
 $R_6 = 6 \Omega; \quad R_7 = 7 \Omega; \quad R_8 = 8 \Omega; \quad R_9 = 8 \Omega; \quad R_{10} = 1 \Omega.$



ES.2 – Dato il circuito in figura, determinare il valore della capacità da inserire tra i punti A e B per rifasare totalmente il carico della linea contenente il generatore.

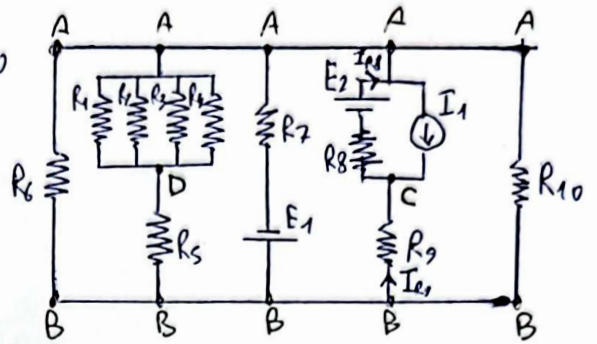
- $e_1(t) = \frac{3\sqrt{2}}{2} \sin(\omega t) \text{ V}; \quad L_1 = 1 \text{ mH}; \quad L_2 = 8.5 \text{ mH};$
 $R_1 = 6 \Omega; \quad R_2 = 2 \Omega; \quad R_3 = 10 \Omega; \quad R_4 = 10 \Omega; \quad \omega = 500 \frac{\text{rad}}{\text{s}};$
 $D = 3.0 \text{ cm}; \quad S = 25 \text{ cm}^2; \quad \mu_r = 1600; \quad N_1 = 500; \quad N_2 = 100.$





$L_1 \rightarrow$ CORTO CIRCUITO

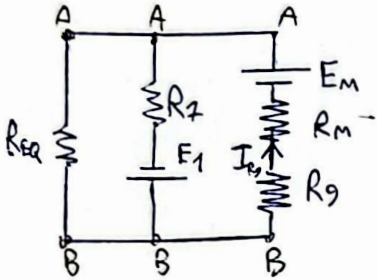
$C_1 \rightarrow$ CIRCUITO APERTO



EFFETTUO IL TAGLIO AI CAPI DI R_{10}

$$R_{EQ} = R_6 \parallel (R_5 + (R_1 \parallel R_2 \parallel R_3 \parallel R_4)) = \left(\frac{1}{R_6} + \left(R_5 + \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \right)^{-1} \right)^{-1} \right)^{-1} = 3,12 \Omega$$

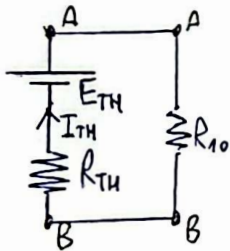
APPLICO MILLMAN TRA A E C $\rightarrow R_M = R_8 \quad E_M = E_2 - R_8 I_1 = -13V$



APPLICO MILLMAN TRA A E B

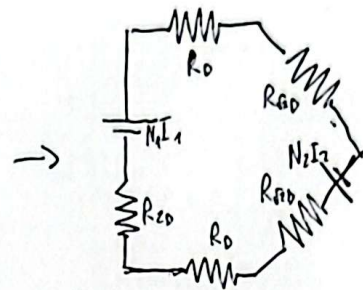
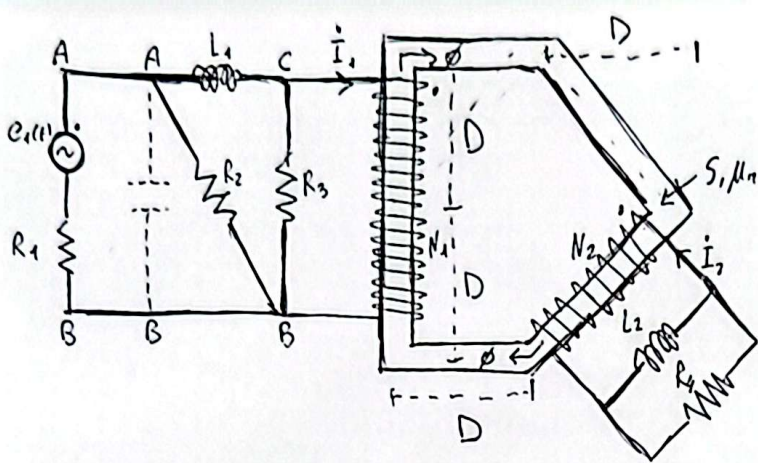
$$R_{TH} = R_{EQ} \parallel R_7 \parallel (R_M + R_9) = \left(\frac{1}{R_{EQ}} + \frac{1}{R_7} + \frac{1}{R_M + R_9} \right)^{-1} = 1,90 \Omega$$

$$E_{TH} = R_{TH} \left(\frac{E_M}{R_M + R_9} - \frac{E_1}{R_7} \right) = -2,90V$$



$$I_{TH} = \frac{E_{TH}}{R_{TH} + R_{10}} = -1,00 A$$

$$W_{L1} = \frac{1}{2} L_1 I_1^2 = 0,01 J$$



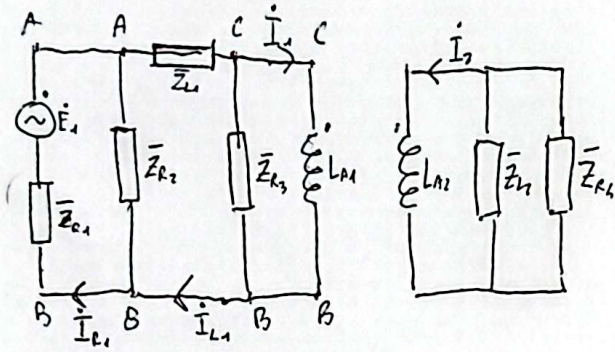
$$R_0 = \frac{D}{\mu_1 \mu_2 S} = 597 \cdot 10^3 \text{ H}^{-1}$$

$$R_{20} = 2R_0 \quad R_{e0} = \sqrt{2} R_0$$

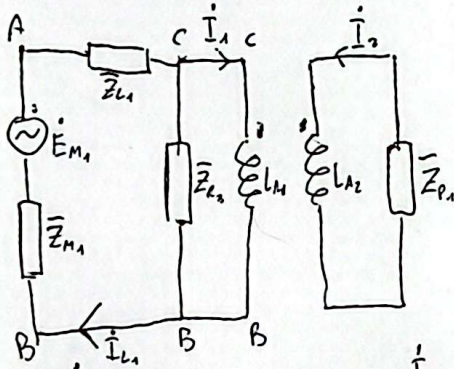
$$R_{e0} = (4 + 2\sqrt{2}) R_0 = 4.08 \cdot 10^4 \text{ H}^{-1}$$

$$L_{A1} = \frac{N_1^2}{R_{e0}} = 6.13 \text{ H} \quad L_{A2} = \frac{N_2^2}{R_{e0}} = 0.25 \text{ H}$$

$$M_{12} = M_{21} = \sqrt{L_{A1} L_{A2}} = 1.23 \text{ H} (> 0)$$



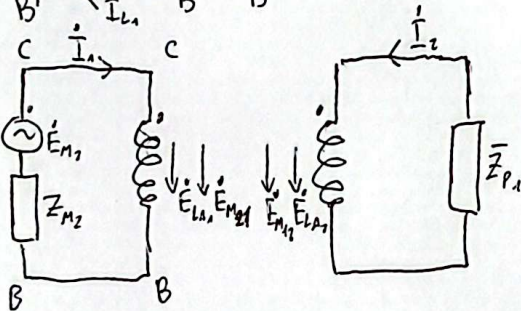
$$\dot{E}_1 = 1.5 \text{ V} \quad \bar{Z}_{R1} = R_1 \quad \bar{Z}_{R2} = R_2 \quad \bar{Z}_{R3} = R_3 \quad \bar{Z}_{L1} = j\omega L_1 \quad \bar{Z}_{L2} = j\omega L_2$$



$$\bar{Z}_{M1} = \left(\frac{1}{\bar{Z}_{R1}} + \frac{1}{\bar{Z}_{R2}} \right)^{-1} = 1.50 \Omega$$

$$\dot{E}_{M1} = \bar{Z}_{M1} \frac{\dot{E}_1}{\bar{Z}_{R1}} = 0.38 \text{ V}$$

$$\bar{Z}_{P1} = \left(\frac{1}{\bar{Z}_{R4}} + \frac{1}{\bar{Z}_{L2}} \right)^{-1} = 1.53 + j3.60 \Omega$$



$$\bar{Z}_{M2} = \left(\frac{1}{\bar{Z}_{R3}} + \frac{1}{\bar{Z}_{L1} + \bar{Z}_{M1}} \right)^{-1} = 1.32 + j0.38 \Omega$$

$$\dot{E}_{M2} = \bar{Z}_{M2} \left(\frac{\dot{E}_{M1}}{\bar{Z}_{L1} + \bar{Z}_{M1}} \right) = 0.33 - j0.01 \text{ V}$$

$$\begin{cases} \dot{E}_{M2} + \dot{E}_{L1} + \dot{E}_{M21} = \bar{Z}_{M2} \dot{I}_1 \\ \dot{E}_{L2} + \dot{E}_{M12} = \bar{Z}_{P1} \dot{I}_2 \end{cases} \rightarrow \begin{cases} \dot{E}_{M2} - j\omega L_{A1} \dot{I}_1 - j\omega M_{21} \dot{I}_2 = \bar{Z}_{M2} \dot{I}_1 \\ -j\omega L_{A2} \dot{I}_2 - j\omega M_{12} \dot{I}_1 = \bar{Z}_{P1} \dot{I}_2 \end{cases} \rightarrow \begin{cases} \dot{I}_1 = \left(\frac{-L_{A2}}{M_{12}} + j \frac{\bar{Z}_{P1}}{\omega M_{12}} \right) \dot{I}_2 \\ \dot{I}_2 = -M_{12} \dot{E}_{M2} (L_{11} \bar{Z}_{P1} + L_{22} \bar{Z}_{M2} - j \frac{\bar{Z}_{P1} \bar{Z}_{M2}}{\omega M_{12}})^{-1} \end{cases}$$

$$\begin{cases} \dot{I}_1 = 0.001 - j0.003 \text{ A} \\ \dot{I}_2 = -0.006 + j0.015 \text{ A} \end{cases}$$

$$\dot{V}_{CB} = \dot{E}_{M2} - \bar{Z}_{M2} \dot{I}_1 = 0.323 - j0.010 \text{ V}$$

$$\dot{I}_{L1} = -\frac{\dot{V}_{CB} - \dot{E}_{M1}}{\bar{Z}_{M1} + \bar{Z}_{L1}} = 0.033 - j0.004 \text{ A}$$

$$\dot{V}_{AB} = \dot{E}_{M1} - \bar{Z}_{M1} \dot{I}_{L1} = 0.323 + j0.006 \text{ V}$$

$$\dot{I}_{R1} = -\frac{\dot{V}_{AB} - \dot{E}_1}{\bar{Z}_{R1}} = 0.196 - j0.001 \text{ A}$$

$$S_{AB} = \dot{V}_{AB} \dot{I}_{R1} = P_{AB} + jQ_{AB} = 0.064 + j0.002 \text{ W} \quad \text{È NECESSARIO RIFASARE}$$

$$C = \frac{Q_{AB}}{\omega \dot{V}_{AB}^2} = 30 \mu\text{F}$$