Compito di Elettrotecnica

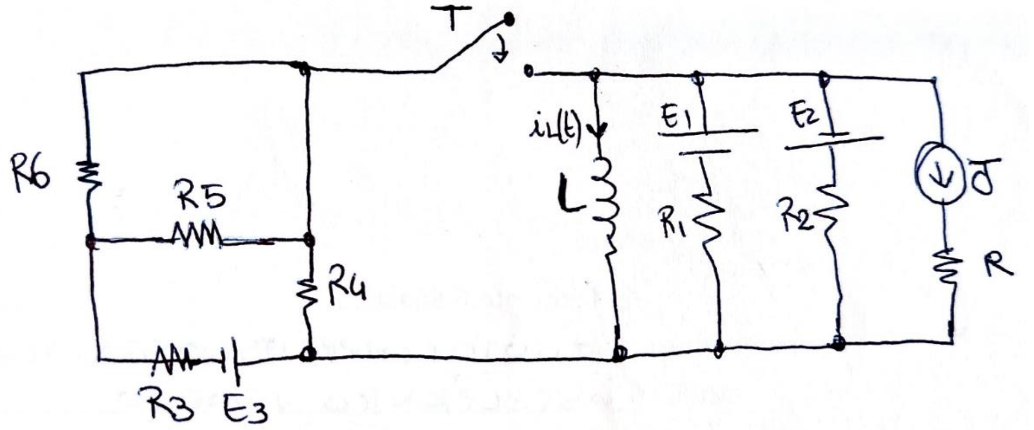
22 Giugno 2022

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

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

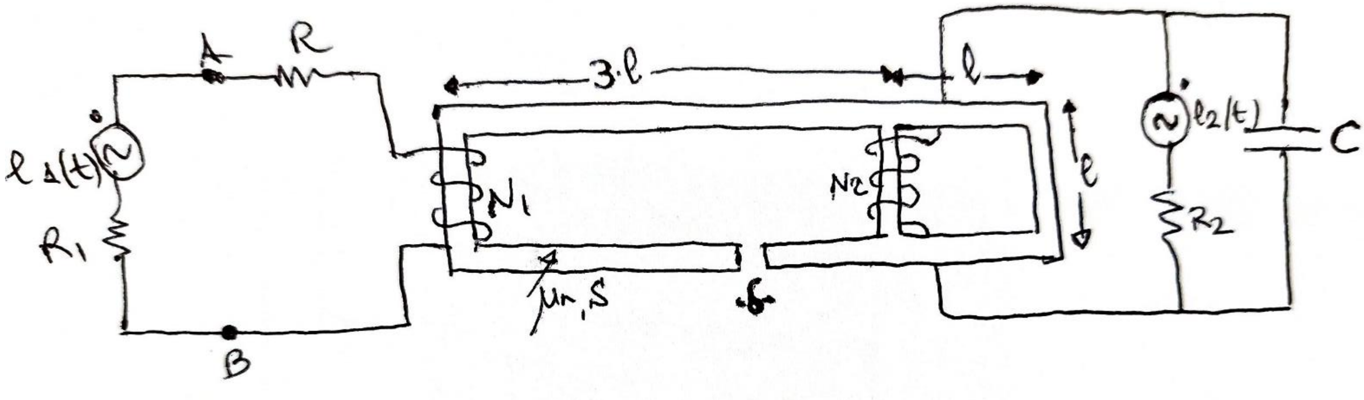
ES.1–Il sistema si trova a regime. Il tasto T all' istante t=0s si chiude. Determinare l'andamento temporale della corrente $i_l(t)$ che scorre su L e il valore della corrente $i_l(t=0.05ms)$.

E_1 = 10V; E_2=3V; E_3=1V; J = 2A; R= 1Ω; R_2=R_3=2 Ω; R_1= R_4 = 3 Ω; R_5= 1.5 Ω; R_6= 2.5 Ω; L=1mH



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 a valle.

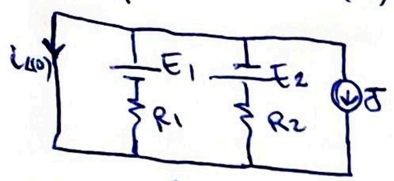
f=50Hz; S=5cm^2; l= 0.5cm; δ=0.25cm; $\mu_r = 1000$; N_1=100; N_2=200; C=5mF; R=R1=R2=3 Ω; $e_1(t) = \sqrt{2}\ \cos\left(wt + \frac{\pi}{2}\right) V$;$e_2(t) = \cos(wt + \frac{\pi}{4})$ V



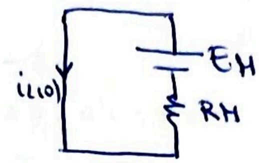
ES. N° 1

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

- T aperto $\Rightarrow V_C(0) \Rightarrow L \Rightarrow$ c.c.



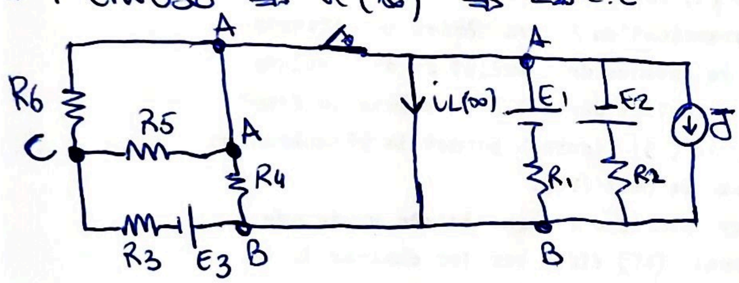
Applico Millman $\Rightarrow$

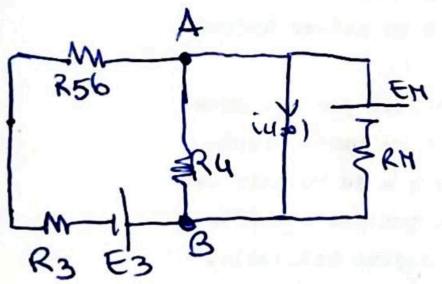


$$E_M = \frac{\frac{E_1}{R_1} - \frac{E_2}{R_2} - J}{\frac{1}{R_1} + \frac{1}{R_2}} \qquad R_M = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

$$i_L(0) = \frac{E_M}{R_M}$$

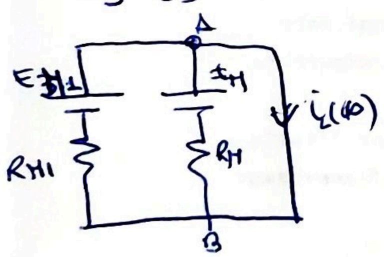
- T chiuso $\Rightarrow V_C(\infty) \Rightarrow L \Rightarrow$ c.c





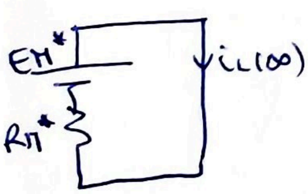
(vedere x il calcolo T aperto)

$$R_{56} = \frac{R_5 \cdot R_6}{R_5 + R_6}$$



$$E_{M1} = \frac{\frac{E_3}{R_3 + R_{56}}}{\frac{1}{R_3 + R_{56}} + \frac{1}{R_4}}$$

$$R_{M1} = \frac{1}{\frac{1}{R_3 + R_{56}} + \frac{1}{R_4}}$$

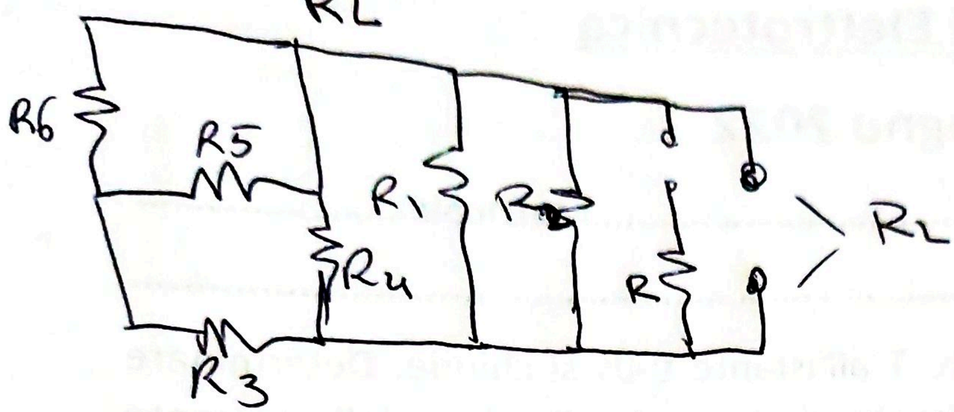


$$E_M^* = \frac{\frac{E_{M1}}{R_{M1}} + \frac{E_{M2}}{R_{M2}}}{\frac{1}{R_{M1}} + \frac{1}{R_{M2}}}$$

$$R_M^* = \frac{1}{\frac{1}{R_{M1}} + \frac{1}{R_{M2}}}$$

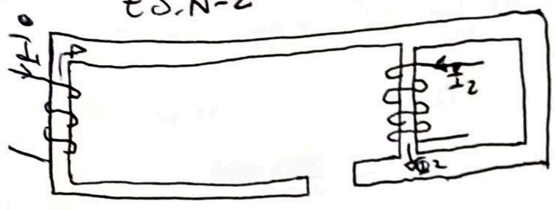
$$i_L(\infty) = \frac{E_M^*}{R_M^*}$$

$- \tau = \frac{L}{R_L}$

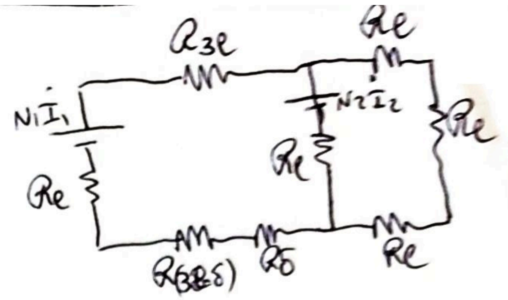


$R_L = \{[(R6 // R5) + R3] // R4\} // R1 // R2$

ES. N° 2



C. equiv. ⇒



$$R_l = \frac{l}{\mu_0 \mu_r S} \qquad R_{3l} = \frac{3l}{\mu_0 \mu_r S}$$

$$R_{(3l-\delta)} = \frac{(3l-\delta)}{\mu_0 \mu_r S} \qquad R_\delta = \frac{\delta}{\mu_r S}$$

$$R_{eq1} = (3R_l // R_l) + R_{3l} + R_l + R_{(3l-\delta)} + R_\delta$$

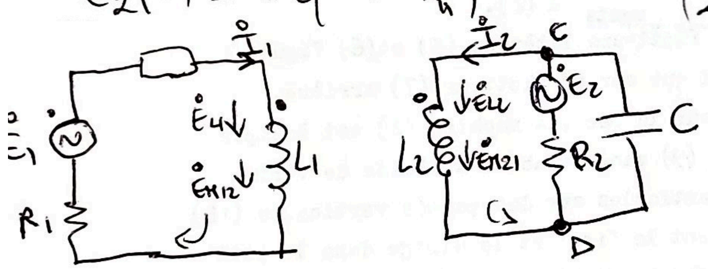
$$R_{eq2} = \{3R_l // (R_{3l} + R_l + R_{(3l-\delta)} + R_\delta)\} + R_l$$

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

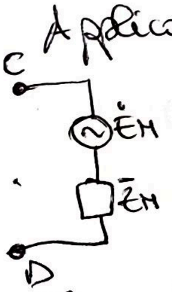
$$M_{12} = M_{21} \; (>0) \qquad M_{12} = \frac{N_1 N_2}{R_{eq1}} \alpha_{12} \qquad \text{dove: } \alpha_{12} = \frac{3R_l}{3R_l + R_l} = \frac{3}{4}$$

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

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



Applico Millman tra C-D:



dove indico $\bar{Z}_C = -\frac{j}{\omega C}$

$$\dot{E}_M = \frac{\frac{\dot{E}_2}{R_2}}{\frac{1}{R_2} + \frac{1}{\bar{Z}_C}} \qquad \bar{Z}_M = \frac{1}{\frac{1}{R_2} + \frac{1}{\bar{Z}_C}}$$

$$\begin{cases} \dot{E}_1 + \dot{E}_{L1} + \dot{E}_{M12} = \dot{I}_1 (R_1 + R) \\ \dot{E}_M + \dot{E}_{L2} + \dot{E}_{M21} = \dot{I}_2 \bar{Z}_M \end{cases}$$

$$\begin{cases} \dot{E}_1 - j\omega L \dot{I}_1 - j\omega M_{12} \cdot \dot{I}_2 = \dot{I}_1 (R_1 + R) \\ \dot{E}_M - j\omega L \dot{I}_2 - j\omega M_{21} \dot{I}_1 = \dot{I}_2 \bar{Z}_M \end{cases} \Rightarrow \dot{I}_1 \text{ e } \dot{I}_2$$

$$\bar{S}_{AB} = \dot{V}_{AB} \cdot \overset{\smile}{I}_1 = \left(\dot{E}_1 - \dot{I}_1 \bar{Z}_1\right) \overset{\smile}{I}_1 = P_{AB} + j\,Q_{AB}$$

se $Q_{AB} > 0 \Rightarrow C_{AB} = \dfrac{Q_{AB}}{\omega V_{AB}^2}$ dove $V_{AB} = |\dot{V}_{AB}|$