Compito di Elettrotecnica

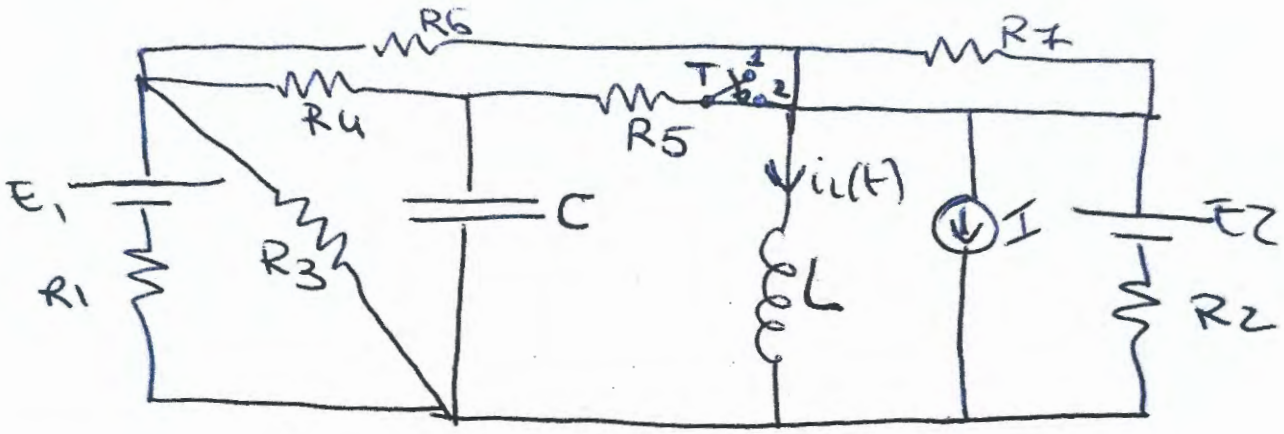
22 Novembre 2022

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

Corso di Laurea.....

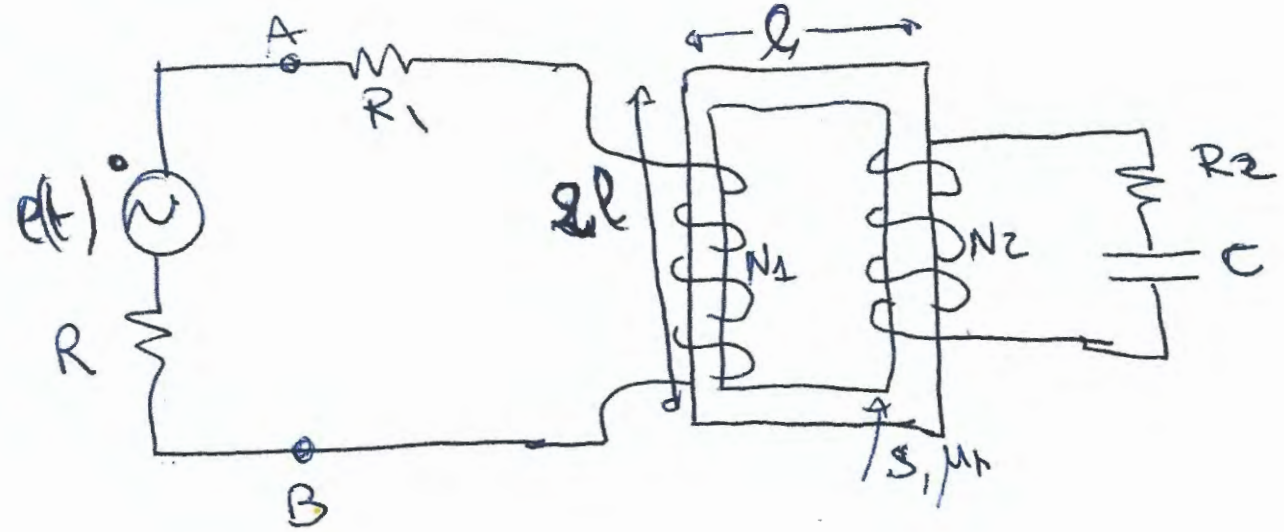
ES.1–Il sistema in figura si trova a regime. Il tasto T all'istante t=0s si chiude. Determinare l'andamento temporale della corrente $i_l(t)$ che scorre su L e l'energia immagazzinata in L dopo *0.05ms* dalla chiusura del tasto.

E_1 = 3V; E_2=8V; I = 2A; $R_i = i\ \Omega$; L=1mH, C=2mF

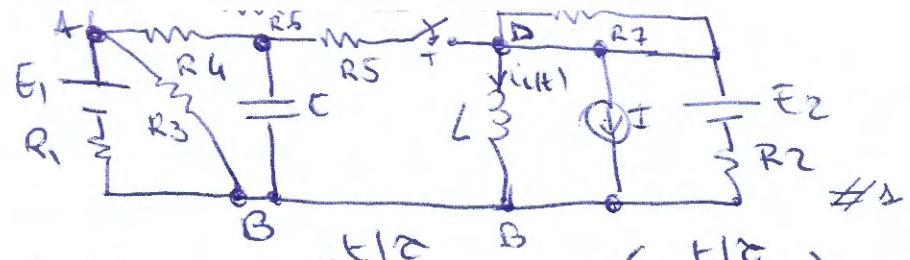


ES.2 – Dato il circuito in figura, determinare il valore della capacità da inserire tra i punti A e B per rifasare totalmente il carico a valle.

f=50Hz; S=4cm^2; l= 0.4cm; $\mu_r = 1000$; N_1=200; N_2=400; C=2.5mF; R=R1=R2=5Ω; $e(t) = \sqrt{2}\cos\left(wt + \frac{\pi}{4}\right)V$



ES N° 1



#1

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

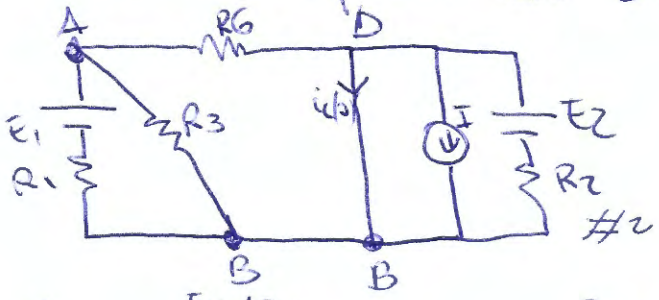
dove: $\tau = \frac{L}{R_L}$

$i_L(0)$ → T aperto

R7 si trascura poiché in // c.c.

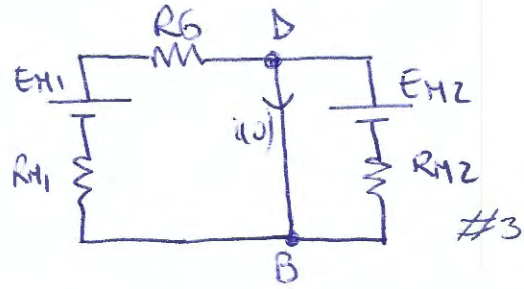
C ⇒ si comporta da c.a

L → si comporta da c.c



#2

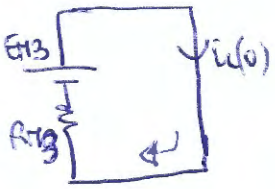
⇒



#3

$$E_{M1} = \frac{E_1/R_1}{\frac{1}{R_1} + \frac{1}{R_3}} \qquad R_{M1} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_3}}$$

$$E_{M2} = \frac{E_2/R_2 - I}{\frac{1}{R_2}} \qquad R_{M2} = R_2$$

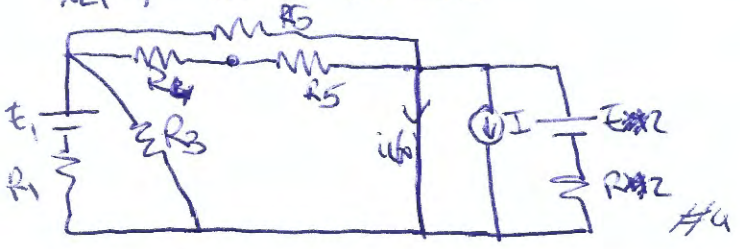


$$E_{M3} = \frac{\frac{E_{M1}}{R_{M1}+R_6} + \frac{E_{M2}}{R_{M2}}}{\frac{1}{R_{M1}+R_6} + \frac{1}{R_{M2}}}$$

$$R_{M3} = \frac{1}{\frac{1}{R_{M1}+R_6} + \frac{1}{R_{M2}}}$$

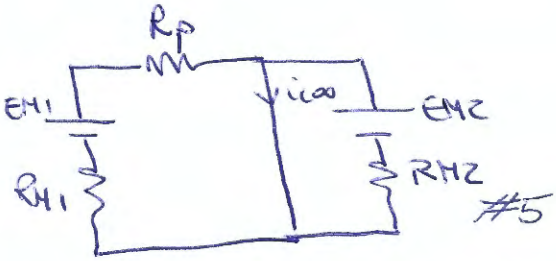
$$i_L(0) = \frac{E_{M3}}{R_{M3}}$$

$i_L(\infty)$ ⇒ T chiuso



#4

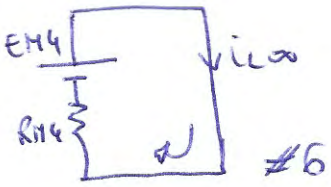
⇒



#5

E_{M1}, R_{M1}, E_{M2}, R_{M2} sono le stesse calcolate nel caso $i_L(0)$

$$R_P = (R_4 + R_5) \,//\, R_6$$



$$E_{M4} = \frac{\frac{E_{M1}}{R_{M1}+R_p} + \frac{E_{M2}}{R_{M2}}}{\frac{1}{R_{M1}+R_p} + \frac{1}{R_{M2}}}$$

$$R_{M4} = \frac{1}{\frac{1}{R_{M1}+R_p} + \frac{1}{R_{M2}}}$$

$$i_L(\infty) = \frac{E_{M4}}{R_{M4}}$$

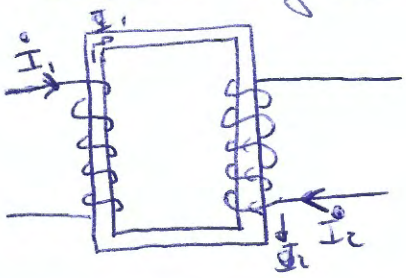
Per il calcolo di $\tau = \frac{L}{R_L}$ posso utilizzare il #6.

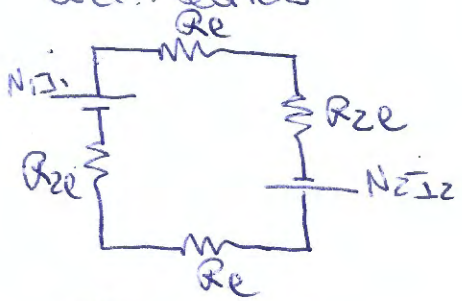
$R_L = R_{M4}$

$W_L = \frac{1}{2} L I_L^2 (t = 0.05\,ms)$

per calcolare l'energia immagazzinata, sostituisco a $t = 0.05$ ms all'espressione temporale della $i_L(t)$.

circuito magnetico ≡ circ. elettrico





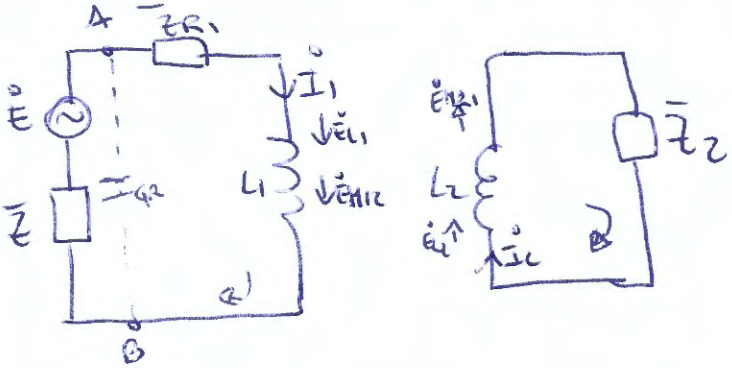
$$R_e = \frac{l}{\mu_0 \mu_r S} \qquad R_{2e} = \frac{2l}{\mu_0 \mu_r S} = 2R_e$$

$$R_{eq} = R_{eq1} = R_{eq2} = 2R_{2e} + 2R_e = 6R_e$$

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

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

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



$$\bar{Z} = R$$
$$\bar{Z}_{R1} = R_1$$
$$\bar{Z}_2 = R_2 - \frac{j}{\omega C}$$

$$\begin{cases} \dot{E} + \dot{E}_{L1} + \dot{E}_{M12} = \dot{I}_1(\bar{Z} + \bar{Z}_{R1}) \\ \dot{E}_{L2} + \dot{E}_{M21} = \dot{I}_2 \bar{Z}_2 \end{cases}$$

$$\begin{cases} \dot{E} - j\omega L_1 \dot{I}_1 - j\omega M_{12} \dot{I}_2 = \dot{I}_1(\bar{Z} + \bar{Z}_{R1}) \\ -j\omega L_2 \dot{I}_2 - j\omega M_{21} \dot{I}_1 = \dot{I}_2 \bar{Z}_2 \end{cases} \Rightarrow \dot{I}_1 \text{ e } \dot{I}_2$$

$$\dot{V}_{AB} = \dot{E} - \bar{Z} \cdot \dot{I}_1$$

$$\bar{S}_{AB} = \dot{V}_{AB} \cdot \dot{I}_1^{*} = P_{AB} + jQ_{AB}$$

Se $Q_{AB} > 0 \Rightarrow C_R = \frac{Q_{AB}}{\omega V_{AB}^2}$