Compito di Elettrotecnica

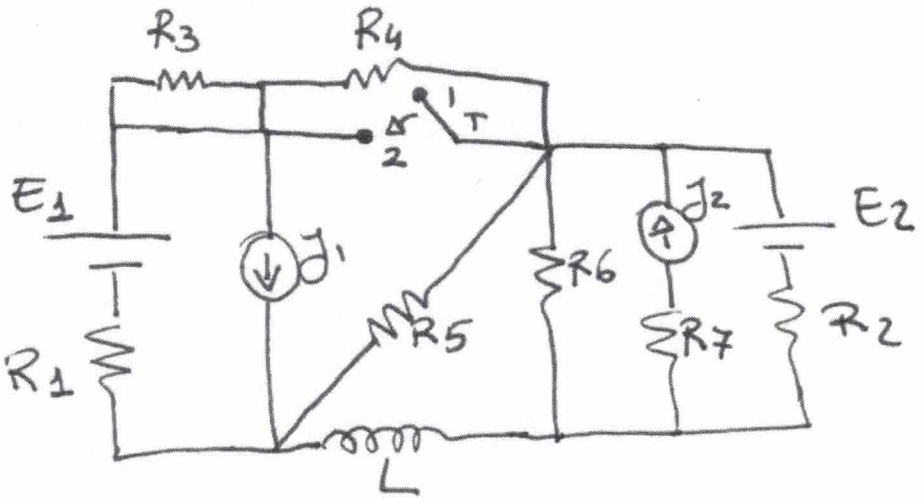
17 Gennaio 2024

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

Corso di Laurea.....

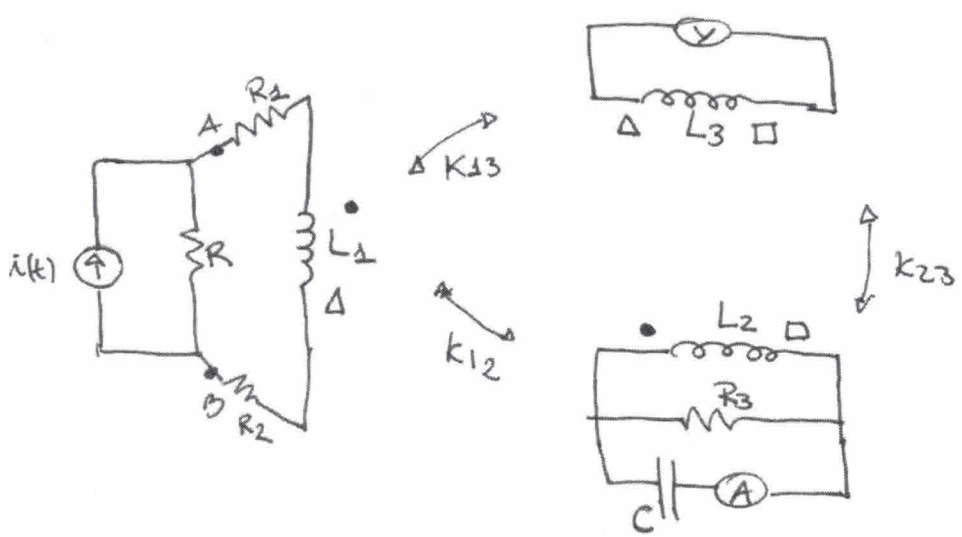
ES.1–Il sistema si trova a regime. All'istante t=0s, il tasto T si chiude. Determinare l'andamento temporale della corrente $i_l(t)$ che scorre su L e la potenza dissipata su R_5.

E_1 = 5V; E_2 = 7V; J_1 = 2A; J_2 = 0.5A; R_1= R_3= R_4=3 Ω; R_2= R_5= R_6= R_7=5 Ω; L=1mH



ES.2 – Dato il circuito in figura a regime, determinare i valori misurati dall'amperometro e dal voltmetro, considerati ideali. Quindi calcolare la capacità da inserire tra i punti A e B per rifasare totalmente il carico a valle.

$i(t) = 2\sqrt{2}\,\mathbf{sin}(wt + \frac{\pi}{3})A$; **R= 1Ω; R_2=2Ω; R_1= R_3=3Ω; L_1=0.5mH; L_2=2mH; L_3=1mH; f = 50Hz; k_{12} = 0.75; k_{13} = 0.8; k_{23}=0.5; C =0.2mF**



Es. N 1

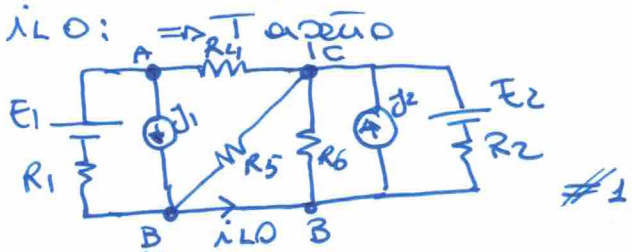
$$i_L(t) = i_{L0}\, e^{-t/\tau} + \left(1 - e^{-t/\tau}\right) i_{L\infty}$$

R_3 Trascurabile in quanto in // ad un c.c.

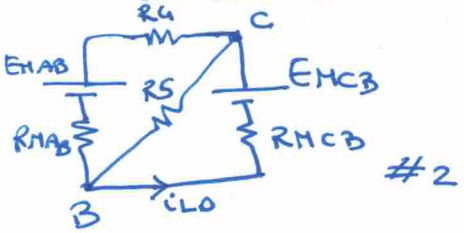
R_7 Trascurabile in quanto in serie ad J

L si comporta da c.c.

i_{L0}: $\Rightarrow$ T aperto



#1



#2

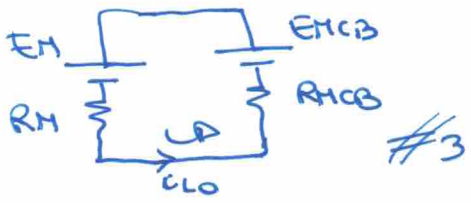
Applico Millmann tra A-B e C-B:

$$E_{MAB} = \frac{\frac{E_1}{R_1} - J_1}{\frac{1}{R_1}}$$

$$R_{MAB} = R_1$$

$$E_{MCB} = \frac{\frac{E_2}{R_2} + J_2}{\frac{1}{R_2} + \frac{1}{R_5}}$$

$$R_{MCB} = \frac{1}{\frac{1}{R_2} + \frac{1}{R_5}}$$



#3

Riapplico Millmann tra C-B:

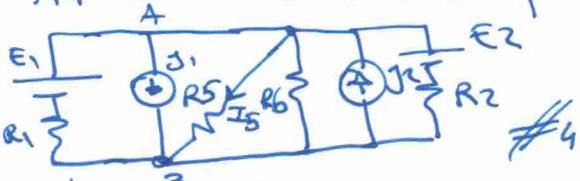
$$E_M = \frac{\frac{E_{MAB}}{R_{MAB}+R_4}}{\frac{1}{R_{MAB}+R_4} + \frac{1}{R_5}}$$

$$R_M = \frac{1}{\frac{1}{R_{MAB}+R_4} + \frac{1}{R_5}}$$

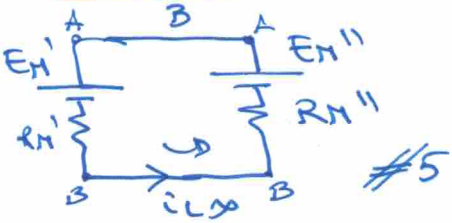
$$i_{L0} = \frac{E_{MCB} - E_M}{R_M + R_{MCB}}$$

$i_{L\infty}$ $\Rightarrow$ T chiuso

R_4 Trascurabile in quanto in // a c.c.



#4



#5

Applico due volte Millmann:

$$E_M' = \frac{\frac{E_1}{R_1} - J_1}{\frac{1}{R_1} + \frac{1}{R_5}}$$

$$R_M' = \frac{1}{\frac{1}{R_1} + \frac{1}{R_5}}$$

$$E_M'' = E_{MCB}$$

$$R_M'' = R_{MCB}$$

$$i_{L\infty} = \frac{E_M'' - E_M'}{R_M' + R_M''}$$

Calcolo $\tau = \frac{L}{R_{eq}}$

R_{eq} viene calcolato rendendo passivo il circuito #4

$$R_{eq} = R_M' + R_M''$$

Infine procedo con il calcolo della potenza dissipata su R5:

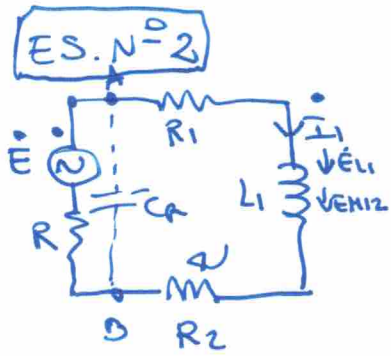
$P = R_5 \cdot I_5^2$

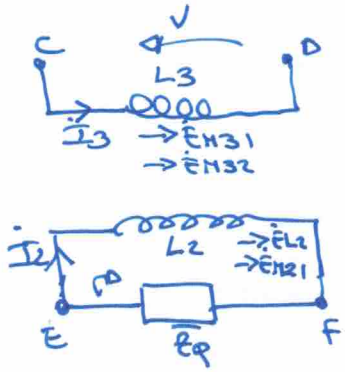
Procedo con il calcolo di I_5:

$I_5 = \frac{V_{AB}}{R_5}$ da #4

Da #5: $V_{AB} = E_H' + i_{L\infty} \cdot R_H'$

ES. N° 2





Il voltmetro si comporta da c.a e l'amperometro da c.c. in quanto entrambi ideali.

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

$M_{23} = k_{23}\sqrt{L_2 L_3} = M_{32}\ (>0)$

$M_{13} = k_{13}\sqrt{L_1 L_3} = M_{31}\ (<0)$

$\dot{I} = 2\left(\cos\frac{\pi}{3} + j\,\text{sen}\frac{\pi}{3}\right) = 2\left(\frac{1}{2} + j\frac{\sqrt{3}}{2}\right) = 1 + j\,1.73\,A$

$\dot{E} = \dot{I} \cdot R = 1 + j\,1.73\,V$

$\bar{Z}_p = \frac{R_3 \cdot \bar{Z}_C}{R_3 + \bar{Z}_C}$ dove: $\bar{Z}_C = -\frac{j}{\omega C}$

$$\begin{cases} \dot{E} + \dot{E}_{L1} + \dot{E}_{M12} = \dot{I}_1 (R + R_1 + R_2) \\ \dot{E}_{L2} + \dot{E}_{M21} = \dot{I}_2 \bar{Z}_p \end{cases} \Rightarrow \begin{cases} \dot{E} - j\omega L_1 \dot{I}_1 - j\omega M_{12} \dot{I}_2 = \dot{I}_1 (R + R_1 + R_2) \\ -j\omega L_2 \dot{I}_2 - j\omega M_{21} \dot{I}_1 = \dot{I}_2 \bar{Z}_p \end{cases}$$

$\hookrightarrow \dot{I}_1 = 0.17 + j\,0.28\,A$

$\dot{I}_2 = 0.02 - j\,0.01\,A$

$V_{CD} = -\dot{E}_{M31} - \dot{E}_{M32} =$

$= -j\omega M_{31} \dot{I}_1 + j\omega M_{32} \dot{I}_2 = 0.05 - j\,0.03\,V$

il valore misurato da V è $V_{CD} = 0.24\,V$

Procedo con il calcolo della C_R da inserire a rifasare:

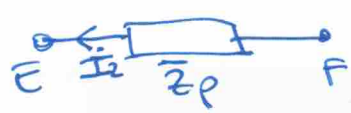
$\bar{S}_{AB} = \dot{V}_{AB} \cdot \overset{\cup}{\dot{I}_1} = \left(\dot{E} - \dot{I}_1 R\right) \cdot \overset{\cup}{\dot{I}_1} = P_{AB} + j\,Q_{AB}$

poiché $Q_{AB} < 0$

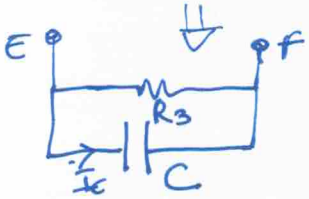
$C_R = \frac{Q_{AB}}{\omega |V_{AB}|^2} = 2.03 \cdot 10^{-5}\,F$

Infine calcolo il valore efficace misurato dall'amperometro:

Ridisegno uno zoom del circuito in cui è presente A:



$\Rightarrow \dot{V}_{EF} = -\dot{I}_2 \bar{Z}_p$



$\dot{I}_C = \frac{\dot{V}_{EF}}{\bar{Z}_C} = -0.0016 - 0.004\,A$

$I_C = 0.07\,A$