Compito di Elettrotecnica

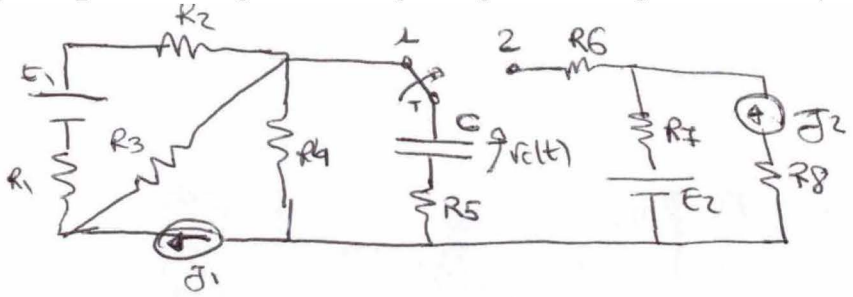
5 Giugno 2024

Nome e Cognome …… Matricola……

Corso di Laurea……

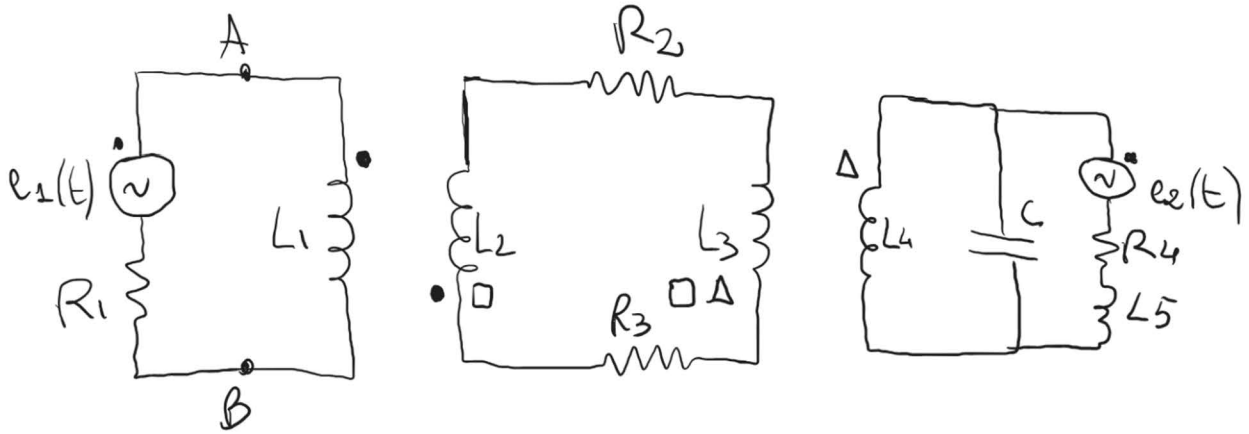
ES.1 – Il seguente circuito si trova a regime. All'istante t=0 il tasto si commuta, determinare l'espressione temporale della tensione ai capi del condensatore C e rappresentare graficamente l'andamento. Il condensatore si carica o si scarica? Inoltre, determinare la potenza generata dal generatore di corrente J2. e la potenza dissipata su R_4

$$\mathbf{E_1 = 1\ V;\ E_2 = 3\ V;\ ;\ J_1 = 1\ A;\ J_2 = 0.5\ A;}$$
$$\mathbf{C = 3\ \mu F;\ R_1 = R_2 = 2\ \Omega;\ R_3 = 1\Omega;\ R_4 = R_5 = 2\Omega;\ R_6 = 10\ \Omega;\ R_7 = R_8 = 2\ \Omega}$$



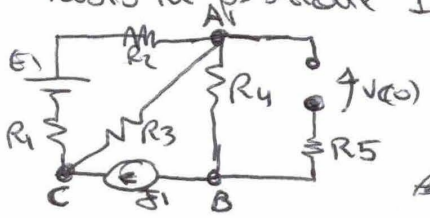
ES.2 – Dato il circuito in figura, determinare il valore del condensatore da inserire tra i punti A e B per rifasare il carico a valle a cos φ =0.98. Inoltre, determinare la potenza reattiva sul condensatore C.

$$\mathbf{e_1(t) = \frac{3\sqrt{2}}{2}\sin\left(\omega t + \frac{\pi}{3}\right)V;\ e_2(t) = \frac{\sqrt{2}}{4}\sin(\omega t + \pi)V;\ C = 3.5\ mF;}$$
$$\mathbf{\omega = 100\ \frac{rad}{s};\ R_1 = 5\Omega;\ R_2 = 2.2\ \Omega;\ R_3 = 5\ \Omega;\ R_4 = 7.5\ \Omega;\ L_1 = 1mH;}$$
$$\mathbf{L_2 = 10mH; L_3 = 20mH; L_4 = 4mH; L_5 = 5mH;\ k_{12} = 0.7; k_{23} = 0.8; k_{34} = 0.9}$$



ESAME 1

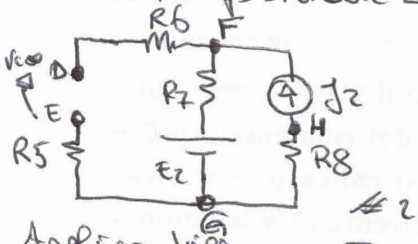
Tasto in posizione 1 $\Rightarrow V_C(0)$ $\Rightarrow$ C si comporta da c.a.



$\nexists 1$

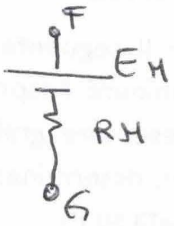
$V_C(0) = V_{AB} = R_4 \cdot J_1 = 2 \cdot 1 = 2V$

Tasto in posizione 2 $\Rightarrow V_C(\infty)$ $\Rightarrow$ C si comporta da c.a.



$\nexists 2$

$V_C(\infty) = V_{DE} = V_{FG}$ $\Rightarrow$



Applico Millmann tra F-G:

$$E_H = \frac{E_2/R_7 + J_2}{\frac{1}{R_7}} = 4V \qquad R_H = R_7 = 2\Omega \qquad V_{FG} = E_H$$

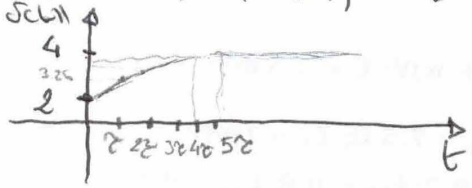
$\tau = R_{eq} \cdot C = 14 \cdot 3\mu = 42\mu s$

$\nexists 3$

$R_{eq} = R_5 + R_6 + R_7 = 14\Omega$

$$v_C(t) = v_C(0)\, e^{-t/\tau} + v_C(\infty)\left(1 - e^{-t/\tau}\right) = 2e^{-t/42\mu} + 4\left(1 - e^{-t/42\mu}\right)$$

$|v_C(0)| < |v_C(\infty)| \Rightarrow$ C si carica



$V_C(0) = 2V$
$V_C(\tau) = 3.26V$
$V_C(2\tau) = 3.72V$
$V_C(4\tau) = 3.96V$
$V_{C\infty}(\infty) = 4V$

$P_{R4} = R_4 \cdot J_4^2 = 2W$

$P_{gen\,J2}$ dal $\nexists 2$ $\quad P_{gen\,J2} = V_{FH} \cdot (-J_2) = -8.5W$

$V_{FG} = V_{FH} + V_{HG} \Rightarrow V_{FH} = V_{FG} - V_{HG} = E_H - (R_8 \cdot (-J_2)) = 4 + \left|2 \cdot \frac{1}{2}\right| = 5V$

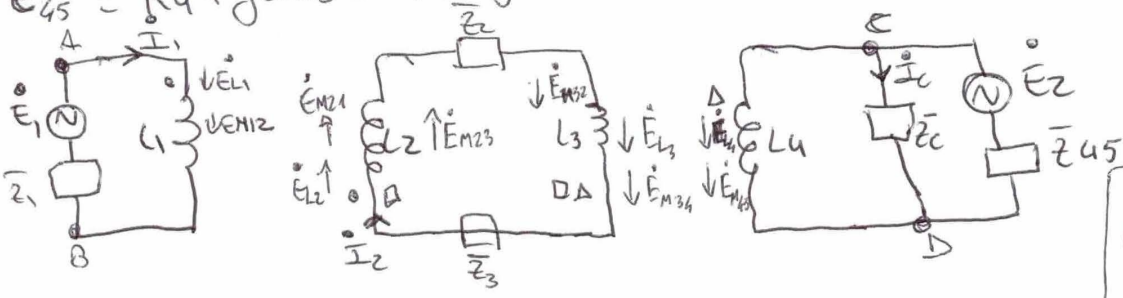
ES. N°2

$\dot{E}_1 = \frac{3}{2}\left(\cos\frac{\pi}{3} + j\,\text{sen}\,\frac{\pi}{3}\right) = 0.75 + j\,1.30$ V

$\dot{E}_2 = \frac{1}{4}\left(\cos\pi + j\,\text{sen}\,\pi\right) = -0.25$ V

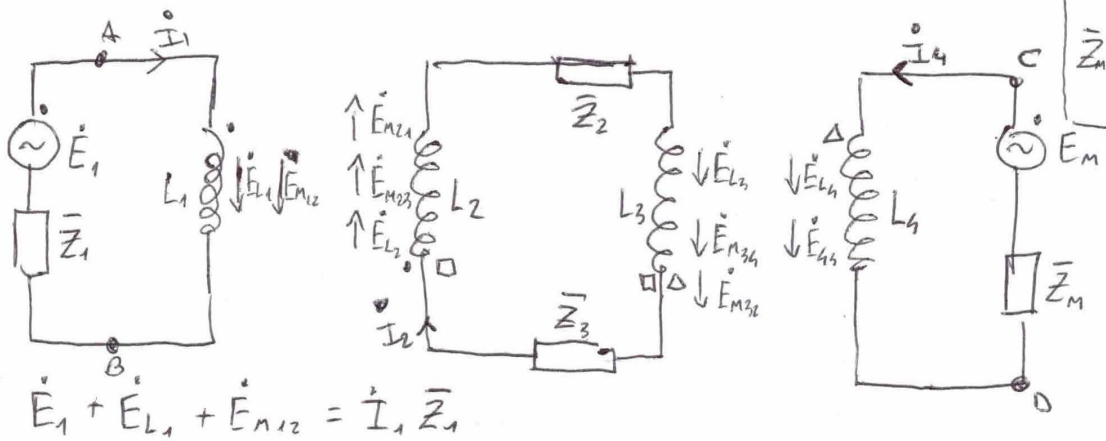
$\bar{Z}_C = \frac{-j}{\omega C} = -j\,2.85\ \Omega$

$\bar{Z}_{45} = R_4 + j\omega L_5 = 7.5 + j\,0.5\ \Omega$



$$\dot{E}_M = \frac{\frac{\dot{E}_2}{\bar{Z}_4}}{\frac{1}{\bar{Z}_4} + \frac{1}{\bar{Z}_C}} = -0.02 + j\,0.086\ \text{V}$$

$$\bar{Z}_M = \frac{1}{\frac{1}{\bar{Z}_4} + \frac{1}{\bar{Z}_C}} = 0.99 - j\,2.5\ \Omega$$



$$\begin{cases} \dot{E}_1 + \dot{E}_{L_1} + \dot{E}_{M12} = \dot{I}_1 \bar{Z}_1 \\ \dot{E}_{L_2} + \dot{E}_{L_3} + \dot{E}_{M23} + \dot{E}_{M21} + \dot{E}_{M34} + \dot{E}_{M32} = \dot{I}_2 (\bar{Z}_2 + \bar{Z}_3) \\ \dot{E}_M + \dot{E}_{L_4} + \dot{E}_{M43} = \dot{I}_4 \bar{Z}_M \end{cases}$$

$M_{12} = M_{21} = k_{12}\sqrt{L_1 L_2} = 2.2$ mH (>0)

$M_{23} = M_{32} = k_{23}\sqrt{L_2 L_3} = 11.3$ mH (<0)

$M_{34} = M_{43} = k_{34}\sqrt{L_3 L_4} = 8.0$ mH (<0)

$$\begin{cases} \dot{E}_1 - j\omega L_1 \dot{I}_1 - j\omega M_{12} \dot{I}_2 = \dot{I}_1 \bar{Z}_1 \\ -j\omega L_2 \dot{I}_2 - j\omega L_3 \dot{I}_3 + j\omega M_{23} \dot{I}_2 - j\omega M_{21} \dot{I}_1 + j\omega M_{34} \dot{I}_4 + j\omega M_{32} \dot{I}_2 = \dot{I}_2 (\bar{Z}_2 + \bar{Z}_3) \\ \dot{E}_M - j\omega L_4 \dot{I}_4 + j\omega M_{43} \dot{I}_2 = \dot{I}_4 \bar{Z}_M \end{cases}$$

$\bar{S}_{AB} = \dot{V}_{AB} \cdot \dot{I}_1^{*} = (\dot{E}_1 - \bar{Z}_1 \dot{I}_1) \cdot \dot{I}_1^{*} = P_{AB} + j\,Q_{AB}$ VAC

SE $Q_{AB} > 0 \rightarrow \Phi_{CA} = \text{arctg}\left(\frac{\text{Im}(\bar{S}_{AB})}{\text{Re}(\bar{S}_{AB})}\right)$

SE $\Phi_{AB} > \Phi_{\text{RICHIESTO}} \rightarrow$ SI DEVE RIFASARE

$$C = \frac{Q_{AB} - P_{AB} \cdot \text{tg}(\Phi_{\text{RICHIESTO}})}{\omega V_{AB}^2}$$

Per calcolare $P_{assorbita\ da\ SUC}$:

$$\bar{S}_{CD} = \dot{V}_{CD} \cdot (\bar{I}_C)^*$$

dove:

$$\dot{V}_{CD} = \dot{E}_H - \dot{I}_H \bar{Z}_H$$

$$\dot{I}_C = \frac{\dot{V}_{CD}}{\bar{Z}_C}$$