Compito di Elettrotecnica

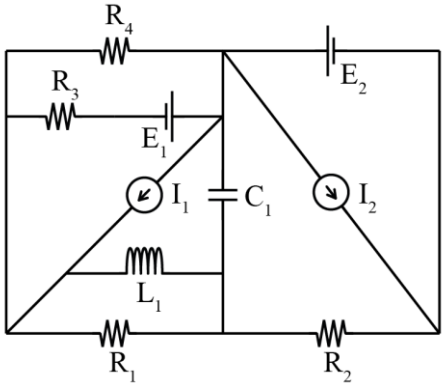
19 Giugno 2024

Nome e Cognome …… Matricola……

Corso di Laurea……

ES.1 – Dato il circuito in figura a regime, determinare il valore dell'energia immagazzinata nel condensatore C_1 e nell'induttore L_1.

$\mathbf{E_1 = 6.3\ V}$; $\mathbf{E_2 = 3\ V}$; $\mathbf{I_1 = 6\ A}$; $\mathbf{I_2 = 1.2\ A}$; $\mathbf{L_1 = 22.7\ mH}$; $\mathbf{C_1 = 3\ mF}$; $\mathbf{R_1 = 3.4\ \Omega}$; $\mathbf{R_2 = 8\ \Omega}$; $\mathbf{R_3 = 16\ \Omega}$; $\mathbf{R_4 = 8\ \Omega}$.

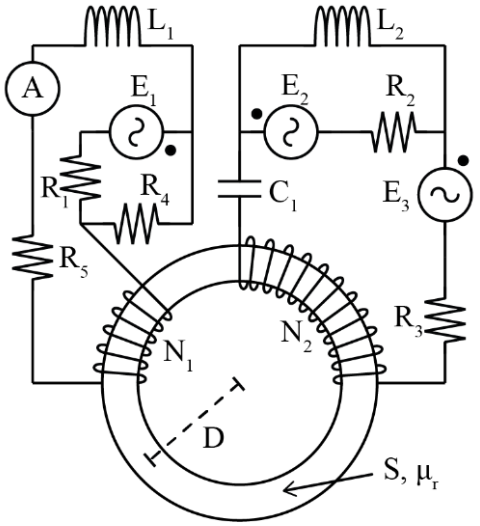


ES.2 – Dato il circuito in figura, determinare la corrente misurata dall'amperometro ideale.

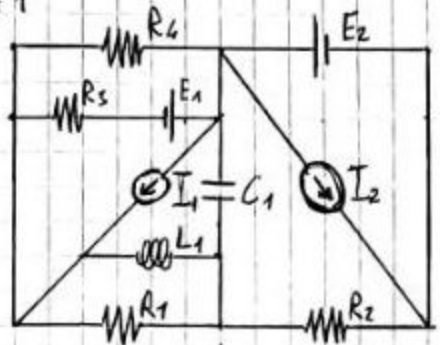
$\mathbf{e_1(t) = 30\sqrt{2}\ \sin(\omega t)\ V}$; $\mathbf{e_2(t) = 20\sqrt{2}\ \sin\left(\omega t + \frac{\pi}{2}\right)\ V}$;

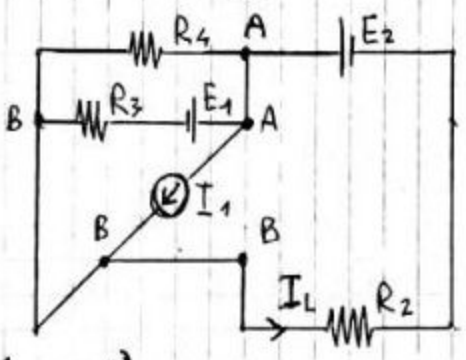
$\mathbf{e_3(t) = 35\sqrt{2}\ \sin(\omega t)\ V}$; $\mathbf{\omega = 1000\ \frac{rad}{s}}$;

$\mathbf{C_1 = 6\ \mu F}$; $\mathbf{L_1 = 2\ mH}$; $\mathbf{L_2 = 3\ mH}$;
$\mathbf{R_1 = 3\ \Omega}$; $\mathbf{R_2 = 2\ \Omega}$; $\mathbf{R_3 = 5\ \Omega}$; $\mathbf{R_4 = 10\ \Omega}$; $\mathbf{R_5 = 2\ \Omega}$;
$\mathbf{D = 1.0\ cm}$; $\mathbf{S = 2\ cm^2}$; $\mathbf{\mu_r = 1600}$; $\mathbf{N_1 = 100}$; $\mathbf{N_2 = 200}$.



Ex 1





$E_1 = 6.3\,V$ $E_2 = 3.0\,V$

$I_1 = 6.0\,A$ $I_2 = 1.2\,A$

$L_1 = 22.7\,mH$ $C_1 = 3\,mF$

$R_1 = 3.4\,\Omega$ $R_2 = 8.0\,\Omega$ $R_3 = 16.0\,\Omega$ $R_4 = 8.0\,\Omega$

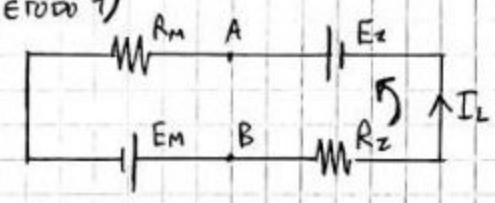
$C_1 \rightarrow$ C.A.

$L_1 \rightarrow$ C.C.

$R_1 \,//$ C.C.

E_2 PREVALENTE SU I_2

METODO 1)



$$R_M = \left(\frac{1}{R_4} + \frac{1}{R_3}\right)^{-1} = 5.33\,\Omega$$

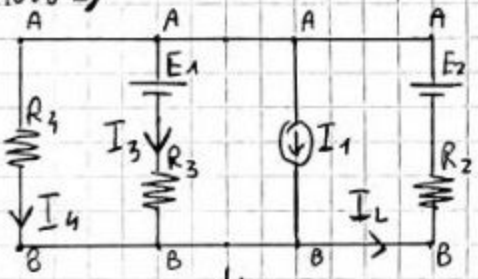
$$E_M = \left(-\frac{E_1}{R_3} + I_1\right) R_M = 29.90\,V$$

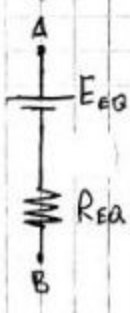
$$E_2 + E_M = R_M I_L + R_2 I_L \rightarrow I_L = \frac{E_2 + E_M}{R_2 + R_M} = 2.47\,A$$

$$E_M + V_{AB} = R_M I_L \rightarrow V_{AB} = R_M I_L - E_M = -16.74\,V$$

$$W_L = \frac{1}{2} L_1 I_L^2 = 0.069\,J \qquad W_C = \frac{1}{2} C_1 V_{AB}^2 = 0.420\,J$$

METODO 2)





$$R_{EQ} = \left(\frac{1}{R_4} + \frac{1}{R_3} + \frac{1}{R_2}\right)^{-1} = 3.20\,\Omega$$

$$E_{EQ} = \left(\frac{E_1}{R_3} - I_1 + \frac{E_2}{R_2}\right) R_{EQ} = -16.74\,V$$

$V_{AB} = E_{EQ} = -16.74\,V$

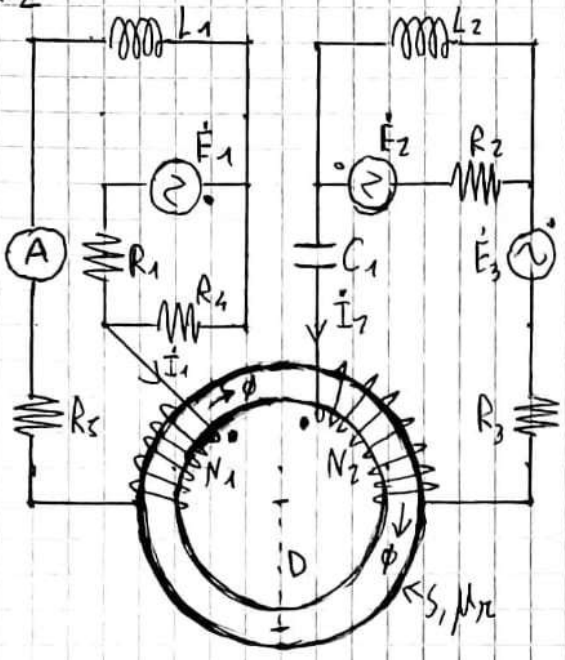
$$-E_1 + V_{AB} = R_3 I_3 \rightarrow I_3 = \frac{V_{AB} - E_1}{R_3} = -1.44\,A$$

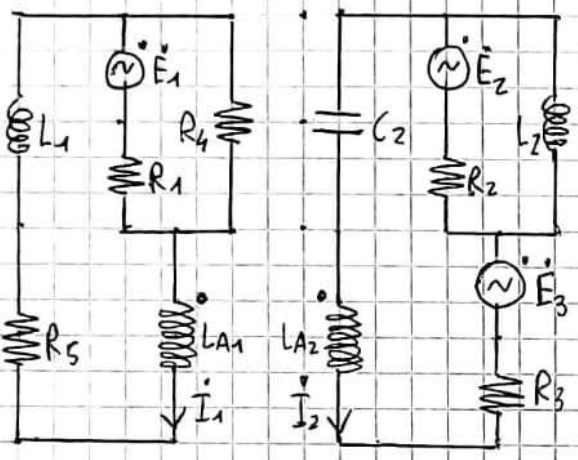
$$V_{AB} = R_4 I_4 \rightarrow I_4 = \frac{V_{AB}}{R_4} = -2.09\,A$$

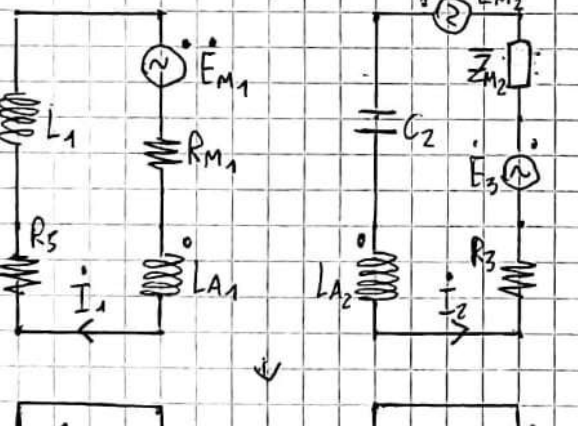
$$I_3 + I_4 + I_1 = I_4 = 2.47\,A$$

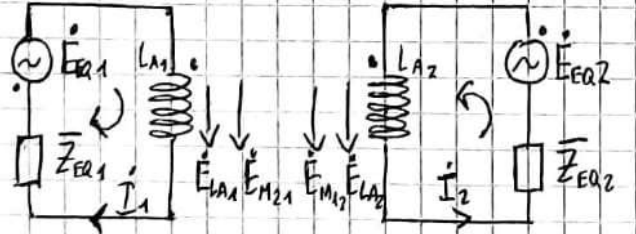
$$W_L = \frac{1}{2} L_1 I_L^2 = 0.069\,J \qquad W_C = \frac{1}{2} C_1 V_{AB}^2 = 0.420\,J$$

Es 2

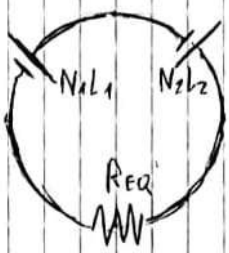








NUCLEO FERROMAGNETICO



$D = 1\,cm \quad S = 2cm^2$

$\mu_r = 1600$

$N_1 = 100 \quad N_2 = 200$

$R_{EQ} = \frac{2\pi D}{\mu_0 \mu_r S} = 1.56 \cdot 10^5\ H^{-1}$

$L_{A1} = \frac{N_1^2}{R_{EQ}} = 0.06\ H \qquad L_{A2} = \frac{N_2^2}{R_{EQ}} = 0.26\ H$

$M_{12} = M_{21} = \sqrt{L_{A1} L_{A2}} = 0.13\ H \ (>0)$

$\dot{E}_1 = 30\ V \quad \dot{E}_2 = j20\ V \quad \dot{E}_3 = 35\ V \quad \omega = 1\,kHz$

$C_1 = 6\,\mu F \quad L_1 = 2\,mH \quad L_2 = 3\,mH$

$R_1 = 3\,\Omega \quad R_2 = 2\,\Omega \quad R_3 = 5\,\Omega \quad R_4 = 10\,\Omega \quad R_5 = 2\,\Omega$

$R_{M1} = \left(\frac{1}{R_1} + \frac{1}{R_4}\right)^{-1} = 2.31\,\Omega$

$\dot{E}_{M1} = \left(\frac{\dot{E}_1}{R_1}\right) R_{M1} = 23.08\ V$

$\bar{Z}_{M2} = \left(\frac{1}{R_2} + \frac{1}{j\omega L_2}\right)^{-1} = 1.38 + j0.92\,\Omega$

$\dot{E}_{M2} = \left(\frac{\dot{E}_2}{R_2}\right) \bar{Z}_{M2} = -9.23 + j13.85\ V$

$\dot{E}_{EQ1} = \dot{E}_{M1} = 23.08\ V$

$\bar{Z}_{EQ1} = R_5 + R_{M1} + j\omega L_1 = 4.31 + j2.00\,\Omega$

$\dot{E}_{EQ2} = \dot{E}_3 + \dot{E}_{M2} = 25.77 + j13.85\ V$

$\bar{Z}_{EQ2} = R_3 + \bar{Z}_{M2} + \frac{1}{j\omega C_2} = 6.38 - j165.74\,\Omega$

$$\begin{cases} \dot{E}_{EQ1} + \dot{E}_{LA1} + \dot{E}_{M21} = \bar{Z}_{EQ1}\,\dot{I}_1 \\ \dot{E}_{EQ2} + \dot{E}_{LA2} + \dot{E}_{M12} = \bar{Z}_{EQ2}\,\dot{I}_2 \end{cases}$$

$$\begin{cases} \dot{E}_{EQ1} - j\omega L_{A1}\dot{I}_1 - j\omega M_{21}\dot{I}_2 = \bar{Z}_{EQ1}\dot{I}_1 \\ \dot{E}_{EQ2} - j\omega L_{A2}\dot{I}_2 - j\omega M_{12}\dot{I}_1 = \bar{Z}_{EQ2}\dot{I}_2 \end{cases} \rightarrow \begin{cases} (-j\omega L_{A1} - \bar{Z}_{EQ1})\dot{I}_1 + (-j\omega M_{21})\dot{I}_2 = -\dot{E}_{EQ1} \\ (-j\omega M_{12})\dot{I}_1 + (-j\omega L_{A2} - \bar{Z}_{EQ2})\dot{I}_2 = -\dot{E}_{EQ2} \end{cases}$$

$\dot{I}_1 = 0.083 - j0.244\ A \qquad \dot{I}_2 = -0.035 - j0.052\ A$

↖ CORRENTE MISURATA DA A → $|\dot{I}_1| = 0.258\ A$