Compito di Elettrotecnica

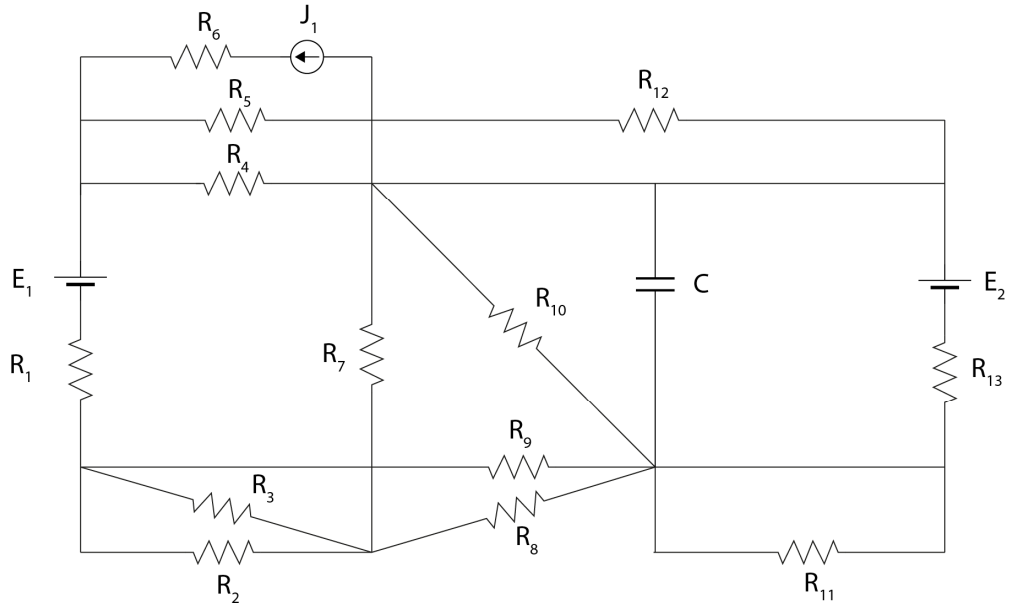
15 Febbraio 2023

Nome e Cognome ……Matricola……

Corso di Laurea…….....

ES.1–Il sistema si trova a regime. Determinare l'energia immagazzinata in C e la potenza generata ed erogata da E_1-R_1.

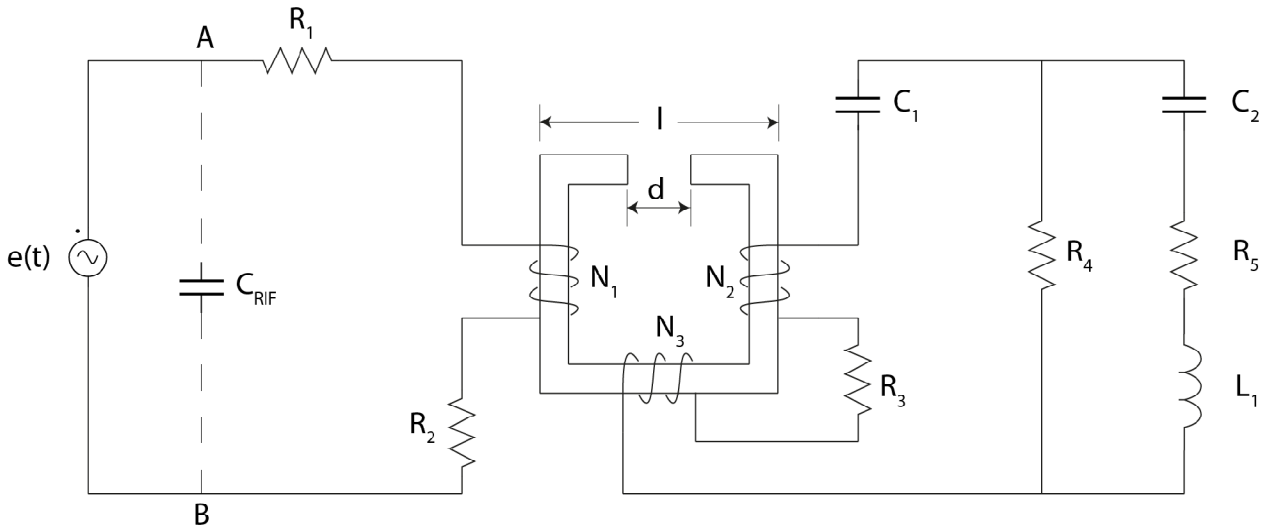
E_1 = 5V; E_2=3V; J_1 = 2A; R_i=i Ω, C=3mF



ES.2 – Il sistema si trova a regime. Determinare il valore della capacità da inserire tra i punti A e B per rifasare totalmente.

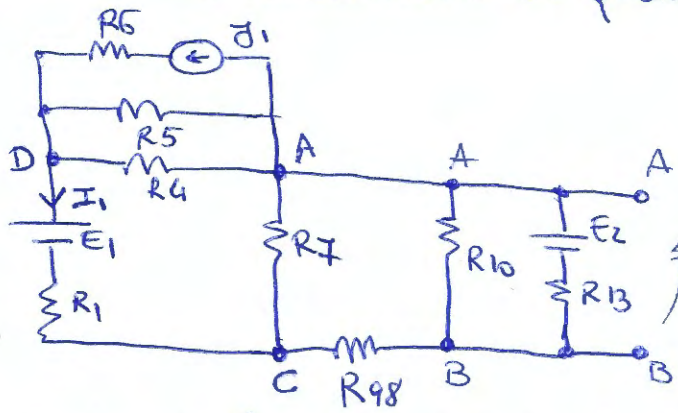
$\boldsymbol{e(t) = \sqrt{2}\ \cos\left(wt + \frac{\pi}{2}\right) V}$**; R_i = i Ω; C_1 =3 mF; C_2 =5 mF; L_1= 0.5 mH; f = 50Hz;**

N_1 = 100; N_2 = 50; N_3 = 200; l = 1cm; d = 0.3 cm; S = 5cm^2; μ_r = 1000



ES N°1

R_2 e R_3 sono trascurabili in quanto in // a c.c, così come R_{12} e R_{11}

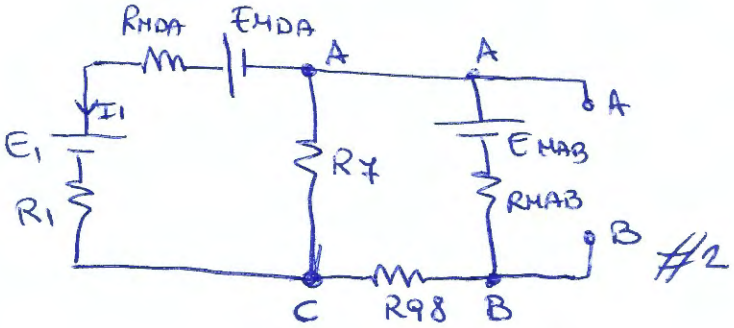


$$R_{98} = \frac{R_9 \cdot R_8}{R_9 + R_8}$$

$V_C = V_{AB}$

#1

Applico Millman tra D-A e ~~A~~ B:



#2

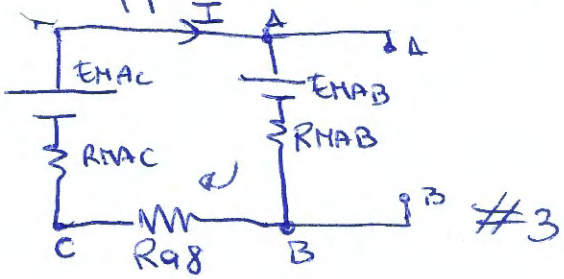
$$E_{HDA} = \frac{J_1}{\frac{1}{R_5} + \frac{1}{R_4}}$$

$$R_{HDA} = \frac{1}{\frac{1}{R_5} + \frac{1}{R_4}}$$

$$E_{HAB} = \frac{E_2 / R_{13}}{\frac{1}{R_{13}} + \frac{1}{R_{10}}}$$

$$R_{HAB} = \frac{1}{\frac{1}{R_{13}} + \frac{1}{R_{10}}}$$

Riapplico Millman tra A-C:



#3

$$E_{HAC} = \frac{\frac{(E_1 - E_{HDA})}{R_1 + R_{HDA}}}{\frac{1}{R_1 + R_{HDA}} + \frac{1}{R_7}}$$

$$R_{HAC} = \frac{1}{\frac{1}{R_1 + R_{HDA}} + \frac{1}{R_7}}$$

$$I = \frac{E_{HAC} - E_{HAB}}{R_{HAC} + R_{HAB} + R_{98}}$$

$$V_{AB} = E_{HAB} + I\, R_{HAB}$$

$$W_C = \frac{1}{2} C V_{AB}^2$$

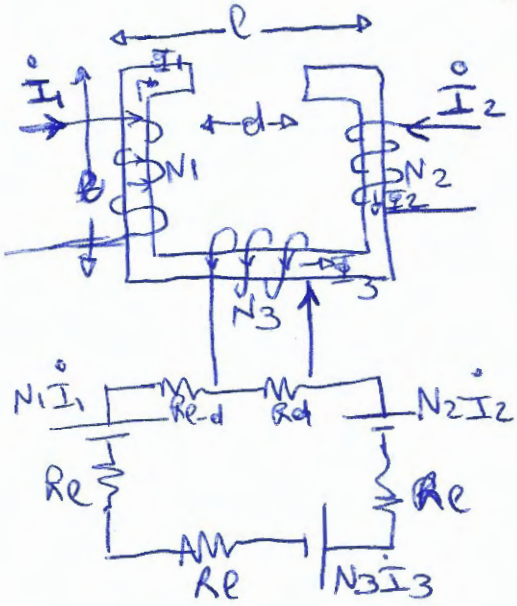
$$P_{gen}(E_1) = E_1 \cdot I_1$$

$$P_{erg}(E_1 - R_1) = V_{DC} \cdot I_1 = (E_1 + I_1 R_1) I_1$$

Dal #3 mi calcolo $V_{AC} = E_{HAC} - I\, R_{HAC}$

Dal #2: $V_{AC} = -E_{HDA} + E_1 + I_1 (R_1 + R_{HDA}) \Rightarrow I_1 = \frac{V_{AC} + E_{HDA} - E_1}{R_1 + R_{HDA}}$

ES. N°2

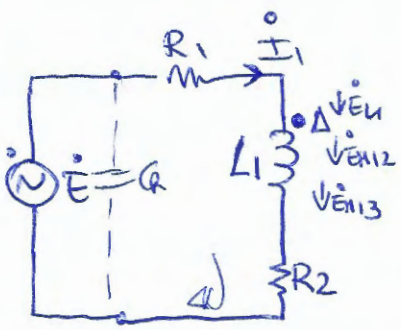


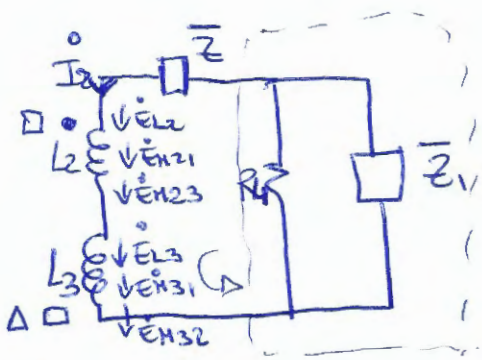
$$M_{12} = M_{21} = \sqrt{L_1 L_2} \quad (>0)$$
$$M_{23} = M_{32} = \sqrt{L_2 L_3} \quad (<0)$$
$$M_{13} = M_{31} = \sqrt{L_1 L_3} \quad (<0)$$

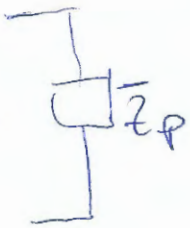
$$R_{eq1} = R_{eq2} = R_{eq3} = R_{eq} = 3R_e + R_{e-d} + R_d$$

$$R_e = \frac{l}{\mu_0 \mu_r S}$$
$$R_{e-d} = \frac{|l-d|}{\mu_0 \mu_r S}$$
$$R_d = \frac{d}{\mu_0 S}$$

$$L_1 = \frac{N_1^2}{R_{eq}} \qquad L_2 = \frac{N_2^2}{R_{eq}} \qquad L_3 = \frac{N_3^2}{R_{eq}}$$







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

$$\bar{Z} = R_3 - \frac{j}{\omega C_1}$$
$$\bar{Z}_1 = R_5 + j\left(\omega L_1 - \frac{1}{\omega C_2}\right)$$
$$\bar{Z}_p = \bar{Z} /\!/ \bar{Z}_1$$

$$\begin{cases} \dot{E} + \dot{E}_{L1} + \dot{E}_{M12} + \dot{E}_{M13} = \dot{I}_1 (R_1 + R_2) \\ \dot{E}_{L2} + \dot{E}_{M21} + \dot{E}_{M23} + \dot{E}_{L3} + \dot{E}_{M31} + \dot{E}_{M32} = \dot{I}_2 (\bar{Z} + \bar{Z}_p) \end{cases}$$

$$\begin{cases} \dot{E} - j\omega L_1 \dot{I}_1 - j\omega M_{12} \dot{I}_2 + j\omega M_{13} \dot{I}_2 = \dot{I}_1 (R_1 + R_2) \\ -j\omega L_2 \dot{I}_2 - j\omega M_{21} \dot{I}_1 + j\omega M_{23} \dot{I}_2 - j\omega L_3 \dot{I}_3 + j\omega M_{31} \dot{I}_1 + j\omega M_{32} \dot{I}_2 = \\ \qquad = \dot{I}_1 (R_1 + R_2) \end{cases}$$

Da questo sistema mi calcolo la $\dot{I}_1$

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

se $Q_{AB} > 0 \Rightarrow C_R = \frac{Q_{AB}}{\omega E^2}$