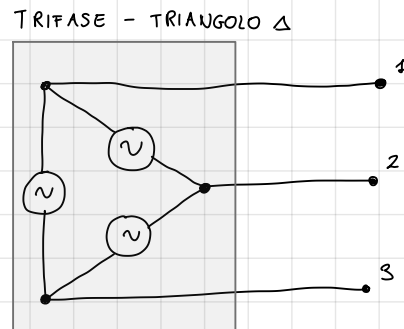
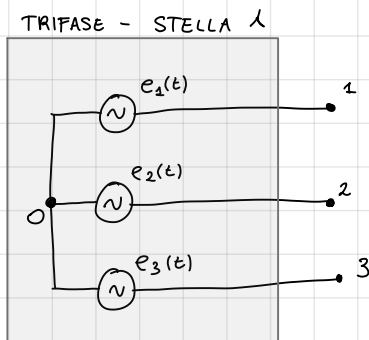
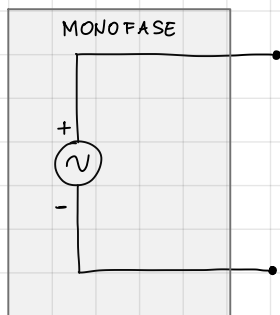


SISTEMI TRIFASE



Faccio riferimento alla conf a λ

$$\ast \frac{2}{3} + \frac{2}{3} = \frac{4}{3}$$

POTENZIALI

$$\begin{aligned} e_1(t) &= U_1 \\ e_2(t) &= U_2 \\ e_3(t) &= U_3 \end{aligned}$$

$$\begin{cases} e_1(t) \Rightarrow \bar{E}_1 = E_0 e^{+j\frac{2}{3}\pi} \\ e_2(t) \Rightarrow \bar{E}_2 = E_0 e^{+j\frac{4}{3}\pi} \\ e_3(t) \Rightarrow \bar{E}_3 = E_0 e^{+j\frac{2}{3}\pi} \end{cases} \leftarrow \text{sfasati di } \frac{2}{3}\pi$$

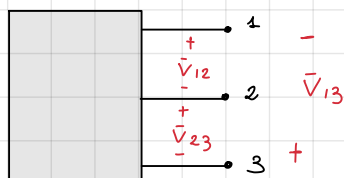
↑
Stesso Valore efficace

TERNA SIMMETRICA

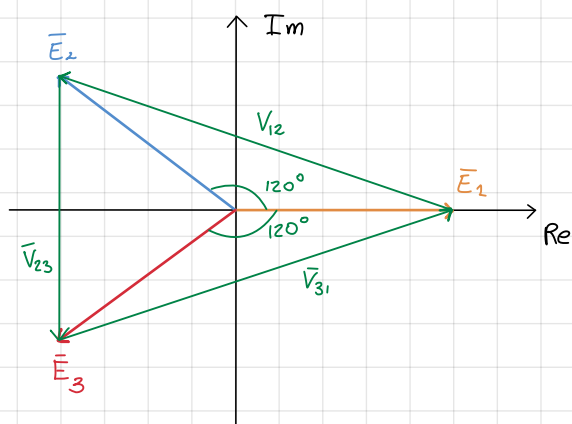
DIRETTA
 $0, +\frac{2}{3}\pi, +\frac{4}{3}\pi$

INVERSA
 $0, -\frac{2}{3}\pi, -\frac{4}{3}\pi$

$$\begin{aligned} \bar{E}_1 &= E_0 \\ \bar{E}_2 &= E_0 \cdot e^{j\frac{2}{3}\pi} = E_0 \angle \frac{2}{3}\pi = E_0 \angle 120^\circ \\ \bar{E}_3 &= E_0 \cdot e^{j\frac{4}{3}\pi} = E_0 \angle \frac{4}{3}\pi = E_0 \angle 240^\circ \end{aligned}$$



$$\begin{aligned} \bar{V}_{12} &= \bar{E}_1 - \bar{E}_2 = E_0 - E_0 \angle \frac{2}{3}\pi \\ \bar{V}_{23} &= \bar{E}_2 - \bar{E}_3 = \\ \bar{V}_{31} &= \bar{E}_3 - \bar{E}_1 = \end{aligned}$$

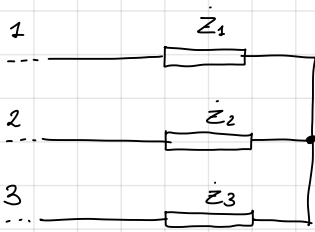


$$V_{12} + V_{23} + V_{31} = 0$$

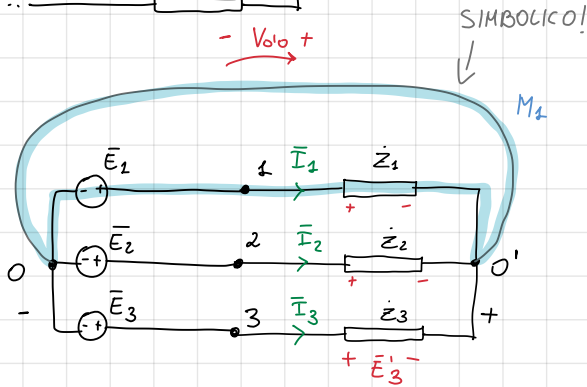
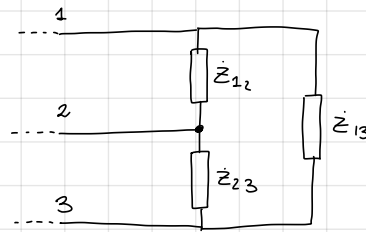
dim: LKT_M: $V_{12} + V_{23} + V_{31} = 0$
oppure con le regole dei vettori

CARICO TRIFASE

STELLA



TRIANGOLO



Se $\bar{E}_1 \neq \bar{E}_2 \neq \bar{E}_3$ e $\bar{Z}_1 \neq \bar{Z}_2 \neq \bar{Z}_3$

$\Rightarrow \bar{V}_{12} \neq \bar{V}_{23} \neq \bar{V}_{31}$, $\bar{I}_1 \neq \bar{I}_2 \neq \bar{I}_3$

(1) LKC_{O'}: $\bar{I}_1 + \bar{I}_2 + \bar{I}_3 = 0$

(2) Vedo $\bar{V}_{O'0}$ come la d.d.p. tra i due centri stella

-o LKT_{M1}: $\bar{E}'_1 - \bar{E}_1 + \bar{V}_{O'0} = 0 \Rightarrow \begin{cases} \bar{E}'_1 = \bar{E}_1 - \bar{V}_{O'0} \\ \bar{E}'_2 = \bar{E}_2 - \bar{V}_{O'0} \\ \bar{E}'_3 = \bar{E}_3 - \bar{V}_{O'0} \end{cases}$

\uparrow Tensioni alle imp.
 \uparrow gen
 \nwarrow d.d.p. O'0

(3) Siccome $\bar{I} = \frac{\bar{E}}{\bar{Z}}$

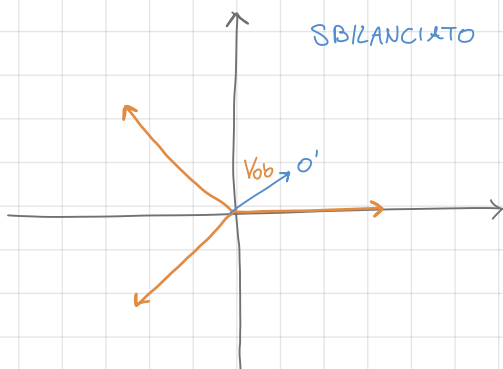
$$\hookrightarrow \frac{\bar{E}'_1}{\bar{Z}_1} + \frac{\bar{E}'_2}{\bar{Z}_2} + \frac{\bar{E}'_3}{\bar{Z}_3} = \frac{\bar{E}_1 - \bar{V}_{O'0}}{\bar{Z}_1} + \frac{\bar{E}_2 - \bar{V}_{O'0}}{\bar{Z}_2} + \frac{\bar{E}_3 - \bar{V}_{O'0}}{\bar{Z}_3} = 0$$

(4) Trovo $V_{O'0}$

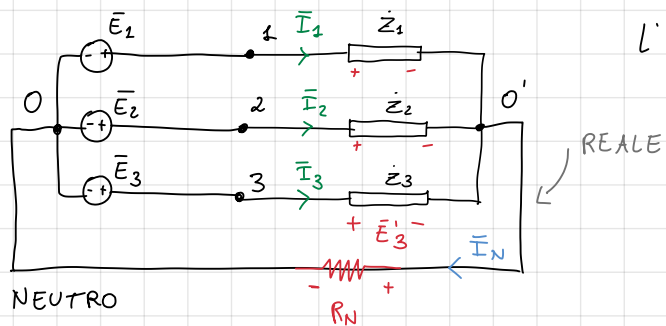
$$\hookrightarrow \frac{E_1}{Z_1} - \frac{V_0}{Z_1} + \frac{E_2}{Z_2} - \frac{V_0}{Z_2} + \frac{E_3}{Z_3} - \frac{V_0}{Z_3} = 0 \Rightarrow V_0 (\dot{Y}_1 + \dot{Y}_2 + \dot{Y}_3) = \dot{Y}_1 E_1 + \dot{Y}_2 E_2 + \dot{Y}_3 E_3$$

$$\Rightarrow \bar{V}_{O'0} = \frac{\dot{Y}_1 E_1 + \dot{Y}_2 E_2 + \dot{Y}_3 E_3}{\dot{Y}_1 + \dot{Y}_2 + \dot{Y}_3}$$

FORMULA DI
MILLMANN



STELLA - STELLA CON NEUTRO



L'obiettivo è ottenere

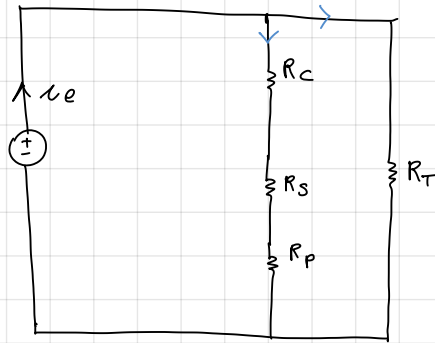
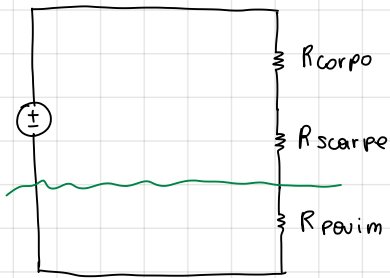
$$\bar{V}_{O'O} = 0$$

Se $R_N = 0 \rightarrow V_{O'O} = 0 = 0$

$$\begin{cases} \bar{E}'_1 = \bar{E}_1 \\ \bar{E}'_2 = \bar{E}_2 \\ \bar{E}'_3 = \bar{E}_3 \end{cases}$$

ma se $R_N \neq 0 \rightarrow \bar{V}_{O'O} = R_N \cdot \bar{I}_N \neq 0 \Rightarrow P_N = |\bar{V}_N| \cdot |\bar{I}_N| = R_N |\bar{I}_N|^2 \neq 0$
 Potenza Sprecata!

NO MESSA A TERRA



Se $R_T \ll R_c + R_s + R_p$

P.C. $\rightarrow I_p = I_e \cdot \frac{R_T}{R_T + R_c + R_s + R_p} \ll I_e$

POTENZA

HP. Abbiamo una T.S.D. con Carico Bilanciato $\rightarrow \bar{E}_1' = \bar{E}_1, \bar{E}_2' = \bar{E}_2, \bar{E}_3' = \bar{E}_3$

$$\hookrightarrow \bar{E}_1 + \bar{E}_2 + \bar{E}_3 = 0$$

$$\begin{cases} e_1(t) = \sqrt{2} E_0 \cos(\omega t) \\ e_2(t) = \sqrt{2} E_0 \cos(\omega t - \frac{2}{3}\pi) \\ e_3(t) = \sqrt{2} E_0 \cos(\omega t - \frac{4}{3}\pi) \end{cases}$$

$$\begin{cases} i_1(t) = \sqrt{2} I_0 \cos(\omega t - \varphi) \\ i_2(t) = \sqrt{2} I_0 \cos(\omega t - \frac{2}{3}\pi - \varphi) \\ i_3(t) = \sqrt{2} I_0 \cos(\omega t - \frac{4}{3}\pi - \varphi) \end{cases}$$

$$\Rightarrow P(t) = P_1(t) + P_2(t) + P_3(t) = 2 E_0 I_0 \left[\cos(\omega t) \cos(\omega t - \varphi) + \right. \\ \left. + \cos(\omega t - \frac{2}{3}\pi) \cdot \cos(\omega t - \frac{2}{3}\pi - \varphi) + \right. \\ \left. + \cos(\omega t - \frac{4}{3}\pi) \cdot \cos(\omega t - \frac{4}{3}\pi - \varphi) \right]$$

Sfrutto $2 \cos(x) \cos(y) = +\cos(x+y) + \cos(x-y)$

$$\hookrightarrow P(t) = E_0 I_0 \cdot \left[\cos(\omega t + \omega t - \varphi) + \cos(\omega t - \omega t + \varphi) + \right. \\ \left. + \cos(\omega t - \frac{2}{3}\pi + \omega t - \frac{2}{3}\pi - \varphi) + \cos(\omega t - \frac{2}{3}\pi - \omega t + \frac{2}{3}\pi + \varphi) + \right. \\ \left. + \cos(\omega t - \frac{4}{3}\pi + \omega t - \frac{4}{3}\pi - \varphi) + \cos(\omega t - \frac{4}{3}\pi - \omega t + \frac{4}{3}\pi + \varphi) \right]$$

$$= E_0 I_0 \left[\underbrace{\cos(2\omega t - \varphi)}_{\text{T.S.D.} = 0} + \underbrace{\cos(\varphi)}_{3\cos(\varphi)} + \right. \\ \left. + \cos(2\omega t - \frac{4}{3}\pi - \varphi) + \cos(\varphi) + \right. \\ \left. + \cos(2\omega t - \frac{8}{3}\pi - \varphi) + \cos(\varphi) \right] = 3 E_0 I_0 \cdot \cos(\varphi)$$

media = istantanea

la Pow di un sistema trifase è
COSTANTE (anche se i gen sono n)

