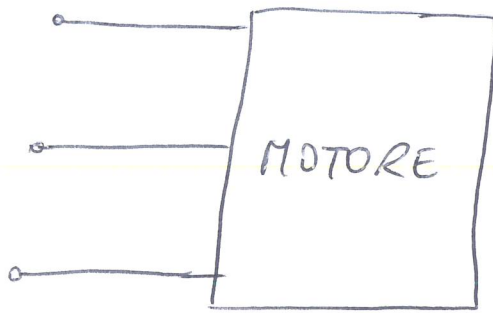


TRIFASE 2

1)



$$600 \text{ V } 3\phi \quad (f = 60 \text{ Hz})$$

$$I_e = 40 \text{ A}$$

$$\cos\varphi = 0.8$$

$$\sin\varphi = 0.6 \quad \varphi = 0.643 \text{ rad}$$

$$P = \sqrt{3} V_e I_e \cos\varphi = 33.26 \text{ kW}$$

$$Q = \sqrt{3} V_e I_e \sin\varphi = 24.94 \text{ kVAR}$$

RIFASAMENTO TRIANGOLO

$$-\omega C V_e^2 + \frac{Q}{3} = 0 \quad C = \frac{24.94 \times 10^3}{3} \frac{1}{\omega 600^2} = 6 \mu\text{F}$$

$$P' = \sqrt{3} V_e I_e' \underbrace{\cos 0}_{\text{RIF.}} \Rightarrow I_e' = \frac{P'}{\sqrt{3} V_e} = 32 \text{ A}$$

$$Z_{\Delta} = 3 Z_{\lambda}$$

$$|Z_{\lambda}| = \frac{600}{\sqrt{3}} \frac{1}{40} = \frac{15}{\sqrt{3}} \Omega$$

$$|Z_{\Delta}| = 15\sqrt{3} = 26 \Omega$$

$$Y_{\Delta} = \frac{1}{Z_{\Delta}} = 30.8 \times 10^{-3} - j 23.1 \times 10^{-3} \text{ S}$$

$$Y_{\Delta}' = 30.8 \times 10^{-3} \text{ S} \Rightarrow Z_{\Delta}' = 32.5 \Omega$$

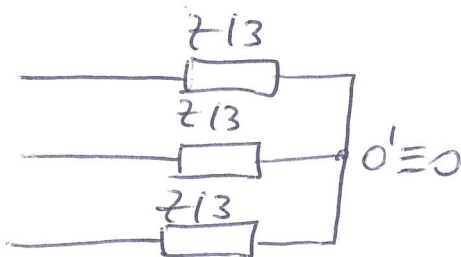
TRIFASE 2

2) CARICO BILANCIATO A TRIANGOLO

$$I_e = 10 \text{ A}$$

$$P = 3 \text{ kW}$$

$$V_e = 220 \text{ V}$$



$$P = \sqrt{3} V_e I_e \cos \varphi$$

$$\cos \varphi = \frac{3000}{\sqrt{3} 220 10} = 0.7873$$

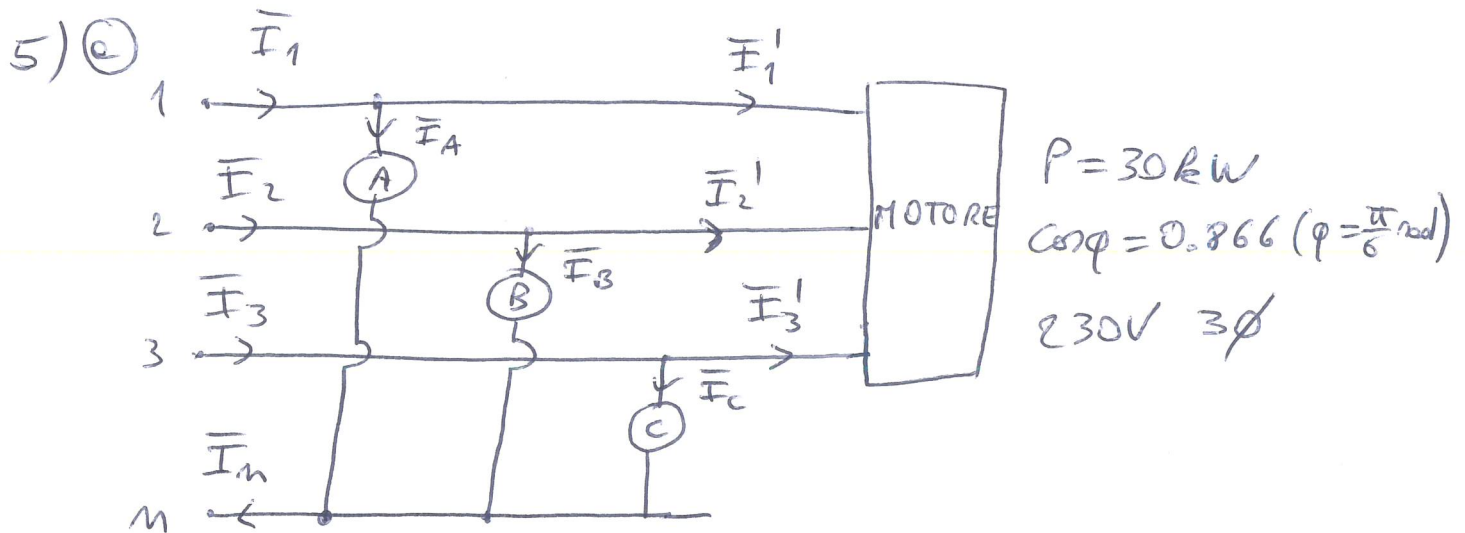
$$\left| \frac{z}{3} \right| = \frac{V_e}{\sqrt{3}} \frac{1}{I_e} = \frac{220}{\sqrt{3}} \frac{1}{10} = 12.7 \Omega$$

$$|z| = 38.1 \Omega$$

$$R = |z| \cos \varphi = 30 \Omega$$

$$X = \pm \sqrt{|z|^2 - R^2} = \pm 23.5 \Omega$$

TRIFASE 2



$$\left. \begin{array}{l} P_A = 10 \text{ kW} \\ P_B = 15 \text{ kW} \\ P_C = 20 \text{ kW} \end{array} \right\} \text{ RIFASATI}$$

$$E_f = \frac{230}{\sqrt{3}} = 133 \text{ V (RIF. FASE)}$$

$$P = \sqrt{3} V_e I_e' \cos \varphi$$

$$\left\{ \begin{array}{l} \bar{I}_1' = \frac{30000}{\sqrt{3} \cdot 230 \cdot 0.866} e^{-j\frac{\pi}{6}} = 87 e^{-j\frac{\pi}{6}} \text{ A} \\ \bar{I}_2' = \bar{I}_1' e^{-j\frac{2}{3}\pi} = 87 e^{-j\frac{5}{6}\pi} \text{ A} \\ \bar{I}_3' = \bar{I}_2' e^{-j\frac{2}{3}\pi} = 87 e^{j\frac{\pi}{2}} = 87j \text{ A} \end{array} \right.$$

$$\left\{ \begin{array}{l} \bar{I}_A = \frac{P_A}{E_f} = \frac{10000}{133} = 75.3 \text{ A} \\ \bar{I}_B = \frac{P_B}{E_f} e^{-j\frac{2}{3}\pi} = 113 e^{-j\frac{2}{3}\pi} \text{ A} \\ \bar{I}_C = \frac{P_C}{E_f} e^{j\frac{2}{3}\pi} = 151 e^{j\frac{2}{3}\pi} \text{ A} \end{array} \right.$$

TRIFASE 2

$$5) \textcircled{e} \quad \bar{I}_1 = \bar{I}_1' + \bar{I}_A = 157 e^{-j0.28} \text{ A}$$

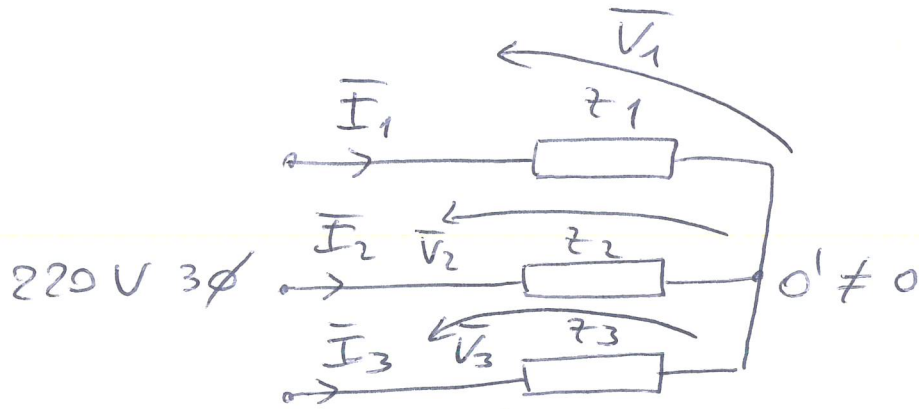
$$\bar{I}_2 = \bar{I}_2' + \bar{I}_B = 164 e^{-j2.2} \text{ A}$$

$$\bar{I}_3 = \bar{I}_3' + \bar{I}_C = 229 e^{j1.9} \text{ A}$$

$$\bar{I}_n = \bar{I}_A + \bar{I}_B + \bar{I}_C = -20 + 41j \text{ A}$$

TRIFASE 2

6) @



$$Z_1 = 2.936 e^{-j0.7} \Omega$$

$$Z_2 = 1.468 e^{j0.225} \Omega$$

$$Z_3 = 2.936 e^{j0.869} \Omega$$

$$\bar{V}_{O'0} = \frac{\bar{E}_1 Y_1 + \bar{E}_2 Y_2 + \bar{E}_3 Y_3}{Y_1 + Y_2 + Y_3}$$

$$Y_1 = 0.34 e^{j0.7} = 0.26 + j0.22 \Omega^{-1}$$

$$Y_2 = 0.68 e^{-j0.225} = 0.66 - j0.15 \Omega^{-1}$$

$$Y_3 = 0.34 e^{-j0.869} = 0.22 - j0.26 \Omega^{-1}$$

$$\bar{E}_1 = 127V ; \bar{E}_2 = 127 e^{-j\frac{2}{3}\pi} V ; \bar{E}_3 = 127 e^{j\frac{2}{3}\pi} V$$

$$\bar{V}_{O'0} = 10.9 e^{j2.87} V$$

$$\bar{V}_1 = \bar{E}_1 - \bar{V}_{O'0} = 137.5 e^{-j0.02} V$$

$$\bar{V}_2 = \bar{E}_2 - \bar{V}_{O'0} = 124.6 e^{-j2} V$$

$$\bar{V}_3 = \bar{E}_3 - \bar{V}_{O'0} = 119.5 e^{j2} V$$

TRIFASE 2

5) (e)

$$\bar{I}_1 = \frac{\bar{V}_1}{z_1} = 46.8 e^{j0.68} \text{ A}$$

$$\bar{I}_2 = \frac{\bar{V}_2}{z_2} = 84.9 e^{-j2.235} \text{ A}$$

$$\bar{I}_3 = \frac{\bar{V}_3}{z_3} = 40.7 e^{j1.16} \text{ A}$$

$$\begin{aligned} P_{cu} &= \bar{V}_1 \bar{I}_1^* + \bar{V}_2 \bar{I}_2^* + \bar{V}_3 \bar{I}_3^* = \\ &= \underbrace{1.85 \times 10^4}_{P_n [\text{W}]} + j \underbrace{1.94 \times 10^3}_{Q_n [\text{VAR}]} \end{aligned}$$

SCON POSIZIONE :

$$\bar{V}_{d1} = 126.9 - j0.76 \text{ V}$$

$$\bar{V}_{i1} = -1.34 + j0.47 \text{ V}$$

$$\bar{V}_0 = 11.95 - j2.46 \text{ V} \quad [\bar{V}_0 \neq \bar{V}_{0'0}]$$

$$\bar{I}_{d1} = 48.2 - j5.1 \text{ A}$$

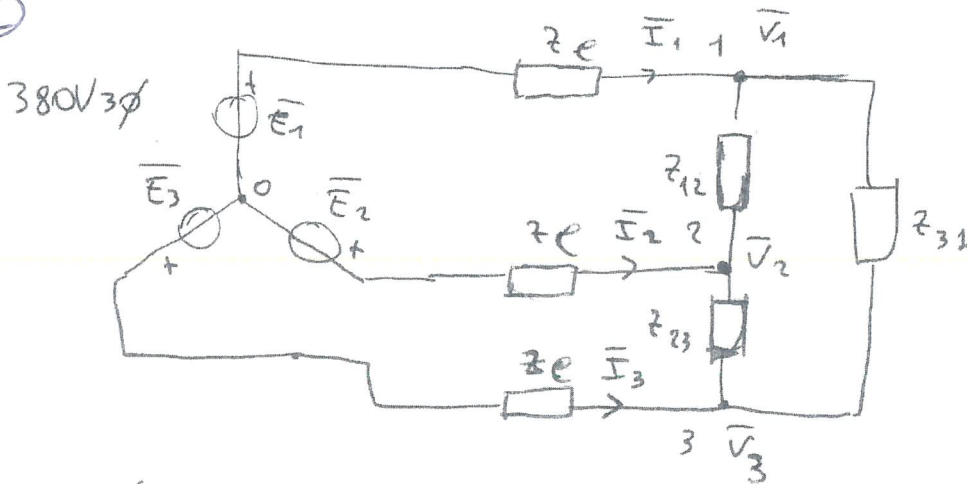
$$\bar{I}_{i1} = -11.9 + j34.5 \text{ A}$$

$$\bar{I}_0 = 0 \text{ A}$$

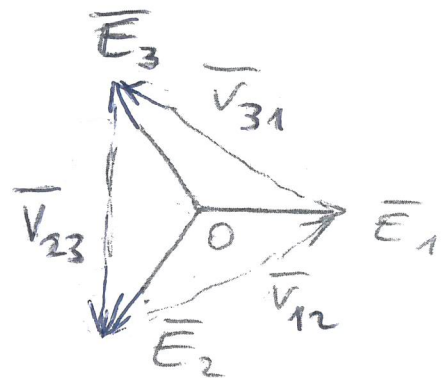
$$\begin{aligned} P_{cu} &= \underbrace{3 \bar{V}_{d1} \bar{I}_{d1}^*}_{1.84 \times 10^4 + j1.82 \times 10^3} + \underbrace{3 \bar{V}_{i1} \bar{I}_{i1}^*}_{96.5 + j122} \end{aligned}$$

TRIFASE 2

7) a)



$$\begin{cases} \frac{\bar{V}_1 - \bar{E}_1}{z_e} + \frac{\bar{V}_1 - \bar{V}_3}{z_{31}} + \frac{\bar{V}_1 - \bar{V}_2}{z_{12}} = 0 \\ \frac{\bar{V}_2 - \bar{E}_2}{z_e} + \frac{\bar{V}_2 - \bar{V}_3}{z_{23}} + \frac{\bar{V}_2 - \bar{V}_1}{z_{12}} = 0 \\ \frac{\bar{V}_3 - \bar{E}_3}{z_e} + \frac{\bar{V}_3 - \bar{V}_1}{z_{31}} + \frac{\bar{V}_3 - \bar{V}_2}{z_{23}} = 0 \end{cases}$$



$|\bar{E}_k| = \frac{380V}{\sqrt{3}}$, $z_e = 1 + j0.2 \Omega$, $z_{12} = 4 + 3j \Omega$, $z_{23} = 8 - j \Omega$, $z_{31} = 6 + 3j \Omega$

$$\begin{cases} \bar{V}_1 \left(\frac{1}{z_e} + \frac{1}{z_{31}} + \frac{1}{z_{12}} \right) - \frac{\bar{V}_2}{z_{12}} - \frac{\bar{V}_3}{z_{31}} = \frac{\bar{E}_1}{z_e} \\ -\frac{\bar{V}_1}{z_{12}} + \bar{V}_2 \left(\frac{1}{z_e} + \frac{1}{z_{23}} + \frac{1}{z_{12}} \right) - \frac{\bar{V}_3}{z_{23}} = \frac{\bar{E}_2}{z_e} \\ -\frac{\bar{V}_1}{z_{31}} - \frac{\bar{V}_2}{z_{23}} + \bar{V}_3 \left(\frac{1}{z_e} + \frac{1}{z_{31}} + \frac{1}{z_{23}} \right) = \frac{\bar{E}_3}{z_e} \end{cases}$$

$$\begin{cases} \bar{V}_1 = 140 + 14.5j \text{ V} \\ \bar{V}_2 = -69 - 14.6j \text{ V} \\ \bar{V}_3 = -72 + 131j \text{ V} \end{cases}$$

$$\begin{cases} \bar{I}_1 = \frac{\bar{V}_1 - \bar{V}_2}{z_{12}} - \frac{\bar{V}_3 - \bar{V}_1}{z_{31}} \\ \bar{I}_2 = -\frac{\bar{V}_1 - \bar{V}_2}{z_{12}} + \frac{\bar{V}_2 - \bar{V}_3}{z_{23}} \\ \bar{I}_3 = \frac{\bar{V}_2 - \bar{V}_1}{z_{31}} - \frac{\bar{V}_2 - \bar{V}_3}{z_{23}} \end{cases}$$

TRIFASE 2

7) (e)

$$\bar{V}_1 - \bar{V}_2 = 209 + 160j \text{ V}$$

$$\bar{V}_2 - \bar{V}_3 = 3 - 277j \text{ V}$$

$$\bar{V}_3 - \bar{V}_1 = -212 + 117j \text{ V}$$

$$|\bar{V}_1 - \bar{V}_2| = 263 \text{ V}$$

$$|\bar{V}_2 - \bar{V}_3| = 277 \text{ V}$$

$$|\bar{V}_3 - \bar{V}_1| = 242 \text{ V}$$

$$\begin{aligned} \bar{I}_1 &= 73 - 29j \text{ A} \\ \bar{I}_2 &= -48 - 35j \text{ A} \\ \bar{I}_3 &= -25 + 64j \text{ A} \end{aligned} \quad \left\{ \begin{aligned} \bar{I}_{12} &= 53 + 0.6j \text{ A} \\ \bar{I}_{23} &= 5 - 34j \text{ A} \\ \bar{I}_{31} &= -21 + 30j \text{ A} \end{aligned} \right.$$

$$|\bar{V}_{e1}| = |\bar{I}_1| |Z_e| = 80 \text{ V}$$

$$|\bar{V}_{e2}| = |\bar{I}_2| |Z_e| = 60 \text{ V}$$

$$|\bar{V}_{e3}| = |\bar{I}_3| |Z_e| = 70 \text{ V}$$

$$\begin{aligned} P_{cu} &= \bar{V}_{12} \bar{I}_{12}^* + \bar{V}_{23} \bar{I}_{23}^* + \bar{V}_{31} \bar{I}_{31}^* = \\ & \underbrace{2.84 \times 10^4}_{P \text{ [W]}} + \underbrace{1.11 \times 10^4 j}_{Q \text{ [VAR]}} \end{aligned}$$

$$P_{3e} = R_e |\bar{I}_1|^2 + R_e |\bar{I}_2|^2 + R_e |\bar{I}_3|^2 = 1.44 \times 10^4 \text{ W}$$

$$P_{CT} = \bar{E}_1 \bar{I}_1^* + \bar{E}_2 \bar{I}_2^* + \bar{E}_3 \bar{I}_3^* = \underbrace{4.28 \times 10^4}_{P_T \text{ [W]}} + \underbrace{1.39 \times 10^4 j}_{Q_T \text{ [VAR]}}$$

TRIFASE 2

7) ©

SENZA RESISTENZE DI LINEA

$$\begin{cases} \overline{V}_{12}^1 = 380 e^{j\frac{\pi}{6}} \text{ V} \\ \overline{V}_{23}^1 = 380 e^{-j\frac{\pi}{2}} \text{ V} \\ \overline{V}_{31}^1 = 380 e^{j\frac{5\pi}{6}} \text{ V} \end{cases}$$

$$\begin{cases} \overline{I}_{12}^1 = 75 - 9j \text{ A} \\ \overline{I}_{23}^1 = 6 - 47j \text{ A} \\ \overline{I}_{31}^1 = -31 + 47j \text{ A} \end{cases}$$

$$\begin{cases} \overline{I}_1^1 = 107 - 56j \text{ A} \\ \overline{I}_2^1 = -70 - 37j \text{ A} \\ \overline{I}_3^1 = -37 + 94j \text{ A} \end{cases}$$

$$\begin{aligned} P_{cu} &= \overline{V}_{12}^1 \overline{I}_{12}^{1*} + \overline{V}_{23}^1 \overline{I}_{23}^{1*} + \overline{V}_{31}^1 \overline{I}_{31}^{1*} = \\ &= \underbrace{6.01 \times 10^4}_{P^1 [\text{W}]} + \underbrace{2.47 \times 10^4 j}_{Q^1 [\text{VAR}]} \end{aligned}$$