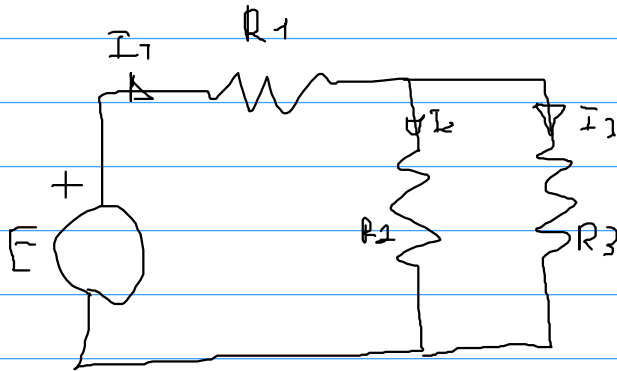


13/09/2024

$$V = R \cdot I$$



$$I_1 = I_{tot}$$

$$P = R \cdot I^2$$

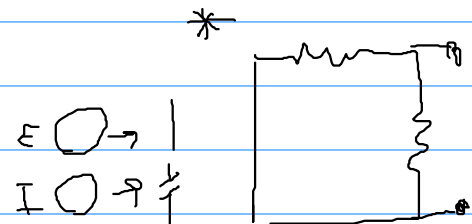
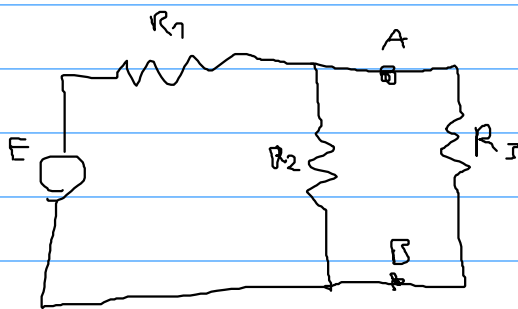
$$I_{tot} = \frac{E}{R_{tot}}$$

$$P_{tot} = E \cdot I_1 = P_E$$

$$P_E = P_{R1} + P_{R2} + P_{R3}$$

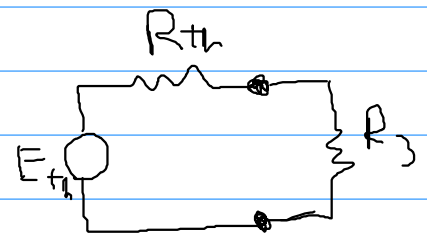
$$I_2 = \frac{I_1}{R_2 + R_3} \cdot R_3$$

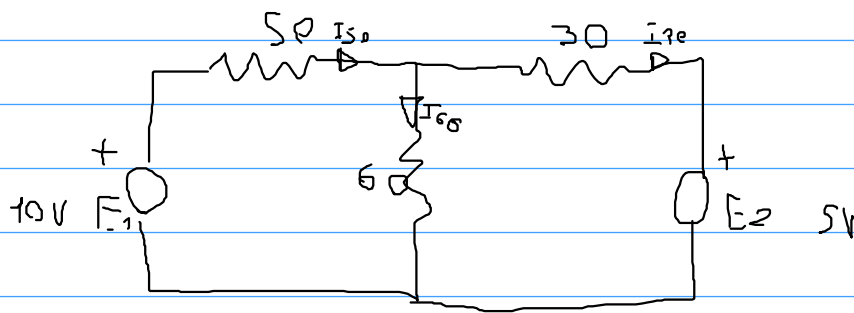
$$I_3 = \frac{I_1}{R_2 + R_3} \cdot R_2$$



$$E_{th} = V_{AB} \text{ (calt su } R_2)$$

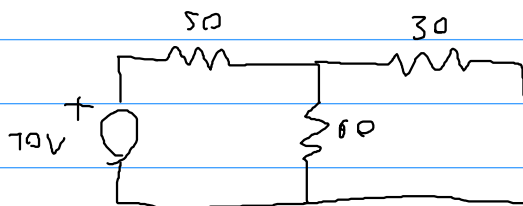
$$* R_{th} = R_1 // R_2$$





$$I_{60} = I_{60}' + I_{60}''$$

$$\begin{array}{cc} \swarrow & \searrow \\ E_{1\text{ on}} & E_{1\text{ off}} \\ E_{2\text{ off}} & E_{2\text{ on}} \end{array}$$



$$R_{\text{tot}} = 50 + \frac{30 \cdot 60}{30 + 60} = 70$$

$$I_{\text{tot}} = \frac{10}{70} = 0,14 \text{ A}$$

$$I_{60} = \frac{0,14}{60 + 30} \cdot 30 = 0,047$$

$$P_{\text{tot}} = 70 \cdot 0,14^2 = 1,4 \text{ W}$$

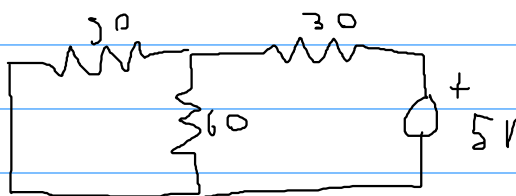
$$\begin{aligned} P_{30} &= 30 \cdot 0,047^2 = 0,26 \\ P_{50} &= 50 \cdot 0,14^2 = 0,98 \\ P_{60} &= 60 \cdot 0,047^2 = 0,13 \end{aligned}$$

$$\downarrow$$

$$1,37 \text{ W}$$

$$I_{50} = 0,14$$

$$I_{30} = \frac{0,14}{60 + 30} \cdot 60 = 0,094$$



$$R_{\text{tot}} = 30 + \frac{50 \cdot 60}{50 + 60} = 57,3$$

$$I_{\text{tot}} = \frac{5}{57,3} = 0,08 \text{ A}$$

$$I_{60} = \frac{0,08}{60 + 50} \cdot 50 = 0,037 \text{ A}$$

$$I_{50} = \frac{0,08}{60 + 50} \cdot 60 = 0,044 \text{ A}$$

$$I_{30} = 0,08 \text{ A}$$

$$\begin{aligned} P_{30} &= 30 \cdot 0,08^2 = 0,38 \\ P_{50} &= 50 \cdot 0,044^2 = 0,1 \\ P_{60} &= 60 \cdot 0,037^2 = 0,1 \end{aligned}$$

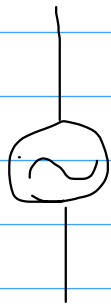
$$P_{\text{tot}} = 5 \cdot 0,08^2 = 0,4 \Rightarrow 0,48$$

$$I_{60} = 0,084$$

$$I_{50} = 0,096$$

$$I_{30} = 0,08$$

Generatore di tensione alternata



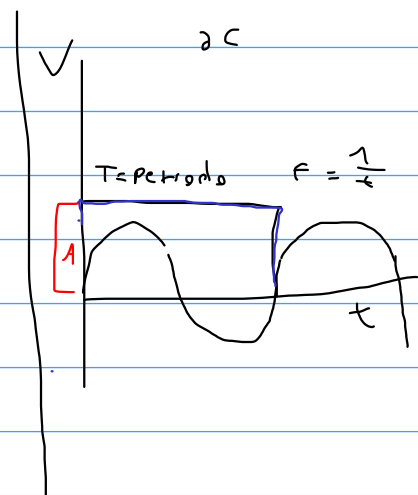
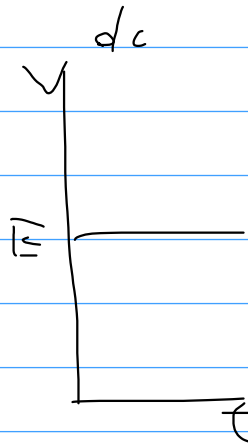
$$E = A \sin(\omega t + \varphi)$$

$$\omega = \text{pulsazione}$$

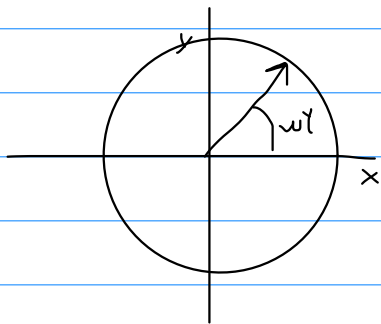
$$= 2\pi f$$

↓
frequenza

$\varphi \Rightarrow \text{fase}$



$$V = A \sin(\omega t)$$



Fasore
= Vettore
rotante
Obligato

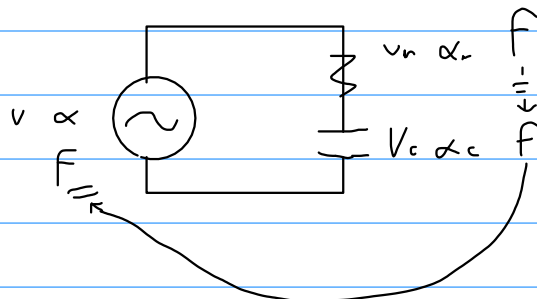
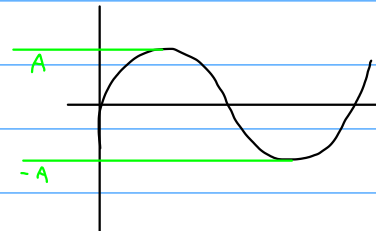
$$f = 50 \text{ Hz}$$

$$\omega = 2\pi \cdot 50 = 314 \text{ rad/s}$$

$$T = \frac{1}{f} = 0,02 \text{ sec}$$

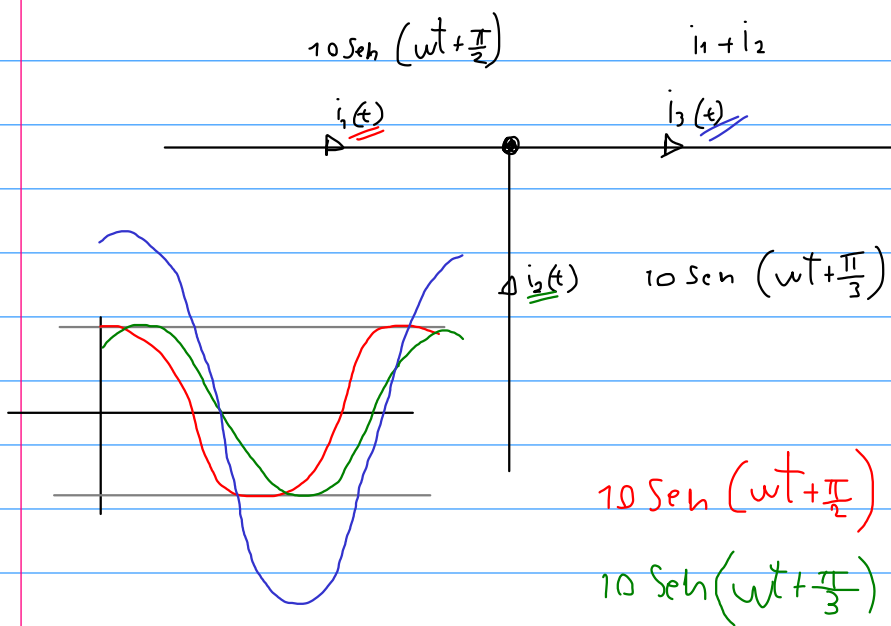
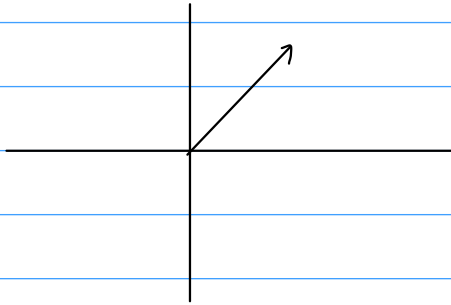
$$y = A \sin(\omega t + \alpha)$$

↓ ↓ ↓
ampiezza puls. fase



$$F = 50 \text{ Hz} \quad \alpha = \frac{\pi}{3}$$

$$v(t) = 5 \sin \left(2\pi \cdot 50 \cdot t + \frac{\pi}{3} \right)$$



$$10 \sin \left(\omega t + \frac{\pi}{2} \right)$$

$$10 \sin \left(\omega t + \frac{\pi}{3} \right)$$



$$i_3 = i_1 + i_2$$

$$i_{3y} = i_{1y} + i_{2y} = 10 + 10 \cdot \frac{\sqrt{3}}{2}$$

$$i_{3x} = i_{1x} + i_{2x} = 0 + 5 = 5$$

$$10 \cdot \cos \left(\frac{\pi}{6} \right)$$

$$10 \cdot \cos \left(\frac{\pi}{3} \right)$$

$$\frac{1}{2}$$

$$i_1 = 10 \sin(2\pi \cdot 50 \cdot t)$$

$$i_2 = 5 \sin(2\pi \cdot 50 \cdot t - \frac{\pi}{2})$$

$$i_3(t) = i_1(t) + i_2(t) = ?$$

$$i_1 x = 10$$

$$i_1 y = 0$$

$$i_2 x = 0$$

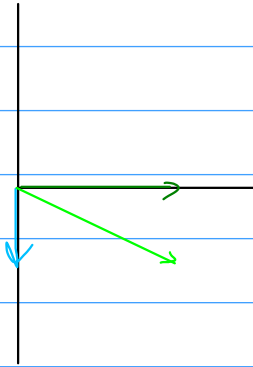
$$i_2 y = -5$$

$$i_3 x = 10$$

$$i_3 y = -5$$

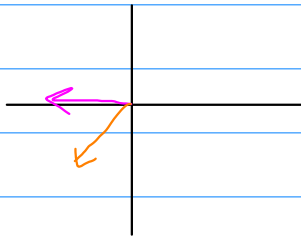
$$x = a + jb$$

$$= 10 - j5$$



$$I_3 = \sqrt{10^2 + (-5)^2} = 5\sqrt{5}$$

$$\tan^{-1}\left(\frac{y}{x}\right) = -0,46$$



$$x = -10 - 10 \sin\left(\frac{\pi}{4}\right) = -10 - 5\sqrt{2}$$

$$\downarrow$$

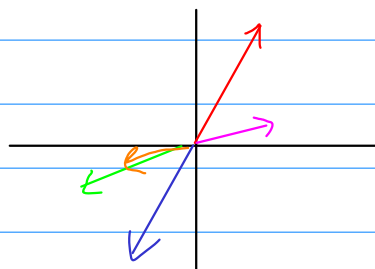
$$\frac{\sqrt{2}}{2}$$

$$\alpha = \frac{\pi}{4}$$

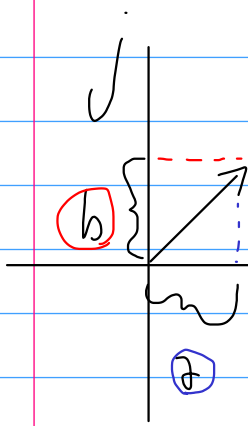
$$l = \text{Pitagora}$$

$$y = 0 - 5\sqrt{2} = -5\sqrt{2}$$

$$-10 \sin\left(2\pi \cdot 50 \cdot t + \frac{\pi}{4}\right)$$



$$3 \sin(\omega t - \frac{5}{6}\pi)$$



$$x = A \sin(\omega t + \varphi)$$

$$\overline{Y} = a + j b$$

numero complesso

$$j^2 = -1$$

NOTAZIONE

$$j = i$$

$$\overline{Y_1} \pm \overline{Y_2}$$

$$(a_1 \pm a_2) + j(b_1 \pm b_2)$$

$$\overline{Y_1} \cdot \overline{Y_2}$$

$$a_1 a_2 + j b_1 a_2 + j b_2 a_1 + j^2 b_1 b_2$$

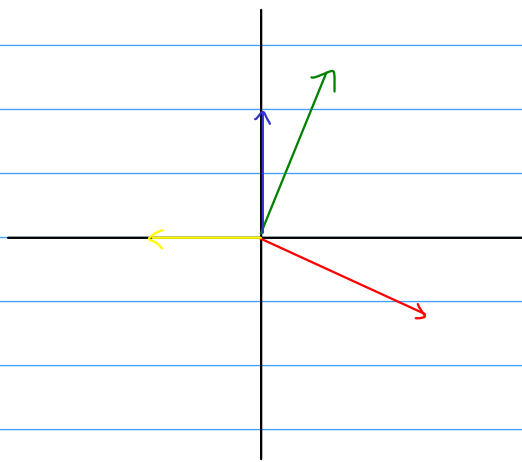
$$(a_1 a_2 - b_1 b_2) + j(b_1 a_2 + b_2 a_1)$$

$$\frac{\overline{Z_1}}{\overline{Z_2}} = \frac{a_1 + j b_1}{a_2 + j b_2}$$

$$= \frac{(a_1 + j b_1)(a_2 - j b_2)}{(a_2 + j b_2)(a_2 - j b_2)}$$

compleso
conjugato

$$= \frac{(a_1 a_2 + b_1 b_2) + j(b_1 a_2 - a_1 b_2)}{a_2^2 + b_2^2}$$



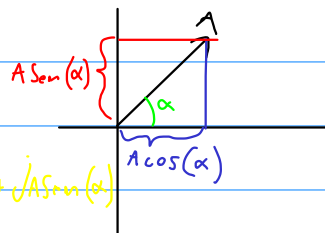
$$y_1 = 10 \operatorname{sen} \left(\omega t + \frac{\pi}{3} \right)$$

$$y_2 = 10 \operatorname{sen} \left(\omega t - \frac{\pi}{6} \right)$$

$$y_3 = 5 \operatorname{sen} \left(\omega t + \frac{\pi}{2} \right) \rightarrow 0, 5$$

$$y_4 = 5 \operatorname{sen} \left(\omega t - \pi \right) \rightarrow -5, 0$$

Fórmulas de Euler



$$\begin{aligned} \tilde{A} &= A \cos(\alpha) + j A \operatorname{sen}(\alpha) \\ &= A (\cos(\alpha) + j \operatorname{sen}(\alpha)) \end{aligned}$$

$$\cos(\alpha) + j \operatorname{sen}(\alpha) = e^{j\alpha}$$

$$\cos(\alpha) - j \operatorname{sen}(\alpha) = e^{-j\alpha}$$

$$\cos(\alpha) = \frac{e^{j\alpha} + e^{-j\alpha}}{2}$$

$$\operatorname{sen}(\alpha) = \frac{e^{j\alpha} - e^{-j\alpha}}{2j}$$

$$\frac{(a_1 + j b_1) \cdot (a_2 + j b_2)}{(a_3 + j b_3) \cdot (a_4 + j b_4)} = \frac{A_1 \cdot A_2}{A_3 \cdot A_4} e^{j(\alpha_1 + \alpha_2 - \alpha_3 - \alpha_4)}$$

$$\sqrt{5^2 + 5^2 \cdot 3} e^{j \frac{\pi}{3}} \quad \sqrt{(5\sqrt{2})^2 + (5\sqrt{2})^2} e^{j \frac{\pi}{4}}$$

$$\frac{(5 + j5\sqrt{3})(5\sqrt{2} - j5\sqrt{2})}{(2\sqrt{3} + j2)}$$

$$\rightarrow \frac{10 \cdot 10}{4} e^{j(\frac{\pi}{3} + \frac{\pi}{4} - \frac{\pi}{6})}$$

$$\sqrt{(2\sqrt{3})^2 + 2^2} e^{j \frac{\pi}{6}}$$