Villamosságtan alapjai (2008.02.10.)

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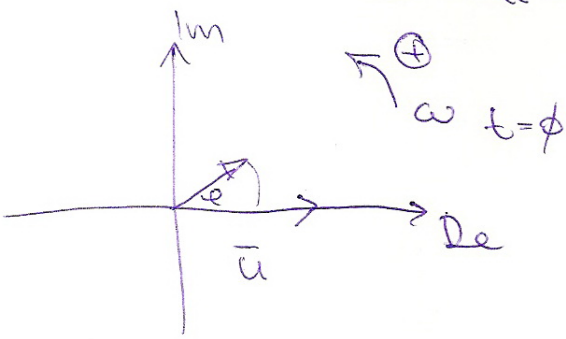
Halmazok:
- 3 fázisú, váltóáramú
- 50 Hz
- több feszültség szintű → trafók
- U, I, Z, S - mennyiségek

$u(t) = U_m \cos(\omega t) = \sqrt{2}\, U_{eff} \cos(\omega t) \rightarrow \bar{U} = U_{eff} e^{j\omega t}$

$i(t) = I_m \cos(\omega t + \varphi) = \sqrt{2}\, U_{eff} \cos(\omega t + \varphi) \rightarrow \bar{I} = I_{eff} e^{j(\omega t + \varphi)}$



$\bar{U} = U$

$\bar{I} = I e^{j\varphi}$

$u(t) = \sqrt{2}\, \mathrm{Re}\{\bar{U}\}$

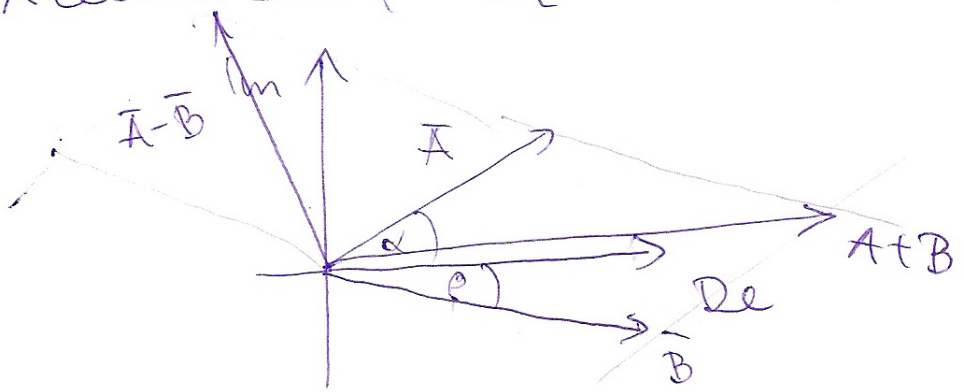
$i(t) = \sqrt{2}\, \mathrm{Re}\{\bar{I}\}$

Komplex aritmetika:

$\bar{A} = A e^{j\alpha} = A\cos\alpha + jA\sin\alpha$

$\bar{B} = B e^{j\beta} = B\cos\beta + jB\sin\beta$

$\bar{A} \pm \bar{B} = A\cos\alpha \pm B\cos\beta + j[A\sin\alpha \pm B\sin\beta]$



$$\bar{A} \cdot \bar{B} = AB\, e^{j(\alpha+\beta)}$$

$$\frac{\bar{A}}{\bar{B}} = \frac{A}{B}\, e^{j(\alpha-\beta)}$$

Ohm-törvény:

$$\bar{U} = \bar{Z} \cdot \bar{I}$$

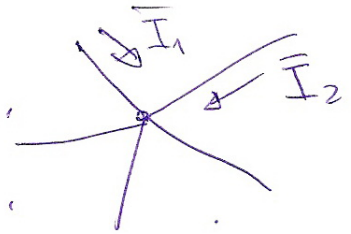
$$U_{eff}\, e^{j\omega t} = Z \cdot I_{eff}\, e^{j(\omega t + \varphi)}$$

$$\bar{Z} = \frac{U_{eff}}{I_{eff}}\, e^{-j\varphi}$$

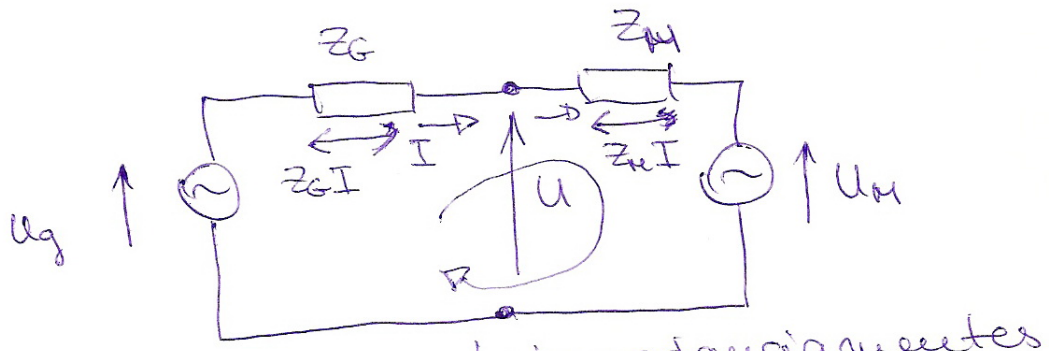
Kirchhoff:

- csomóponti

$$\sum_{i=1}^{n} \bar{I}_i = 0$$



- hurok



Lo impedanciamentes földpotenciálon

↑ Ter. emelkedés szimbolizálása

U_g: $\bar{U}_g$ de nem jelöljük

$$U_g - Z_G I - Z_M I - U_M = 0 \rightarrow I = \frac{U_g - U_M}{Z_g + Z_M}$$

$$U_g - Z_G I - U = 0 \rightarrow U = U_g - Z_g I$$

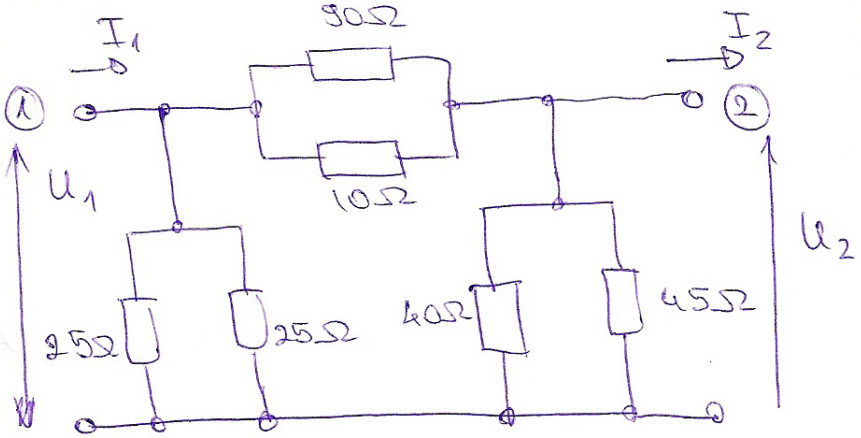
Eljesítményi összefüggés:

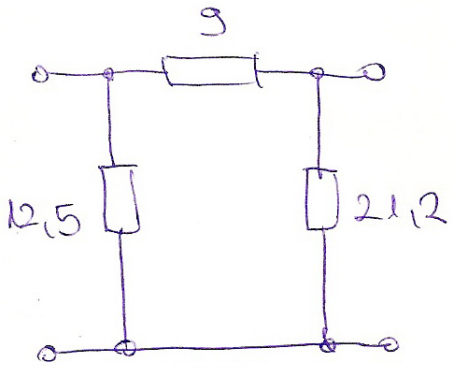
$$\bar{S} = \bar{U} \cdot \bar{I}^* = P + jQ$$

- $|\bar{S}|$ látszólagos [VA]
- P hatásos [W]
- Q meddő [var]

$\mu : 10^{-6}$
$m : 10^{-3}$
$k : 10^{3}$
$M : 10^{6}$

Mérésponti- & transfer impedancia:





Π

$$Z_{11}\Big|_{\bar{u}j:\, I_2=\phi} = 8{,}8\,\Omega$$

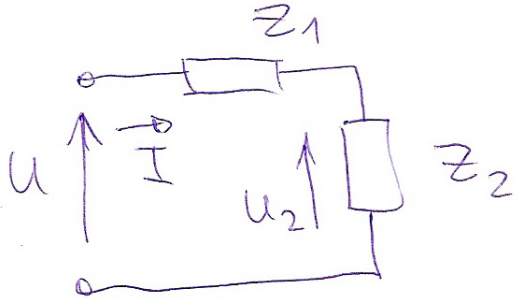
$$Z_{12}\Big|_{u_2=\phi:\, r_2} = \frac{U_1}{I_2} = 9\,\Omega$$

$$Z_{11}\Big|_{r_2:\, U_2=\phi} = 5{,}2\,\Omega$$

$$I_2 = I_1 \frac{12{,}5}{12{,}5+9}$$

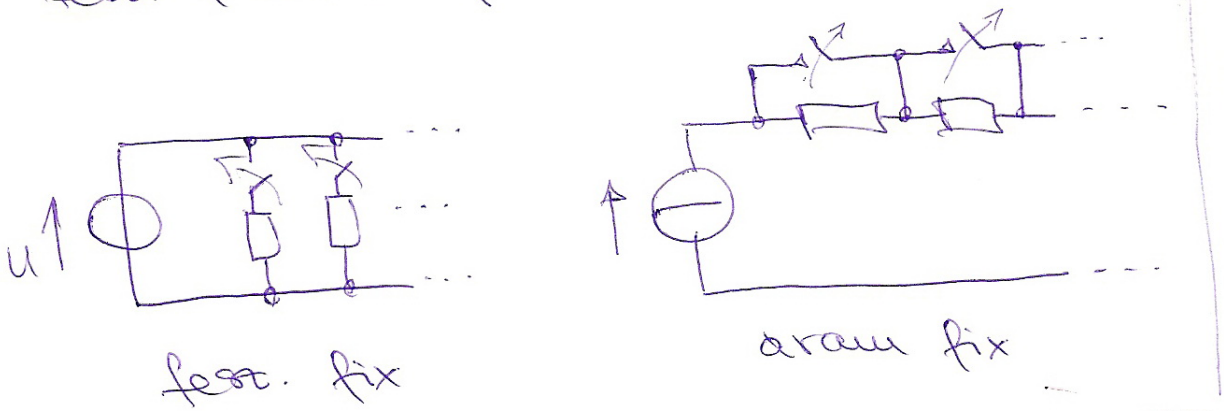
$$I_1 = \frac{U_1}{5{,}2}$$

F

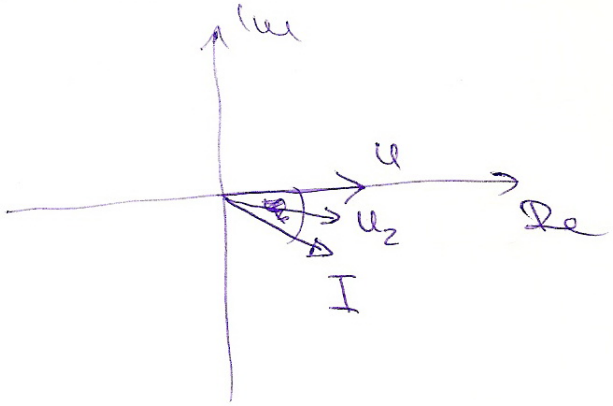


$U = 240\,V$
$Z_1 = 1 + j3\,\Omega$
$Z_2 = 10 + j2\,\Omega$
$I = ?$ $U_2 = ?$ $S_2 = ?$

Fesz. & áram generátor:



$$I = \frac{U}{Z_1 + Z_2} = 19\,A \angle -24°$$



$$U_2 = U \frac{Z_2}{Z_1 + Z_2} = 194\,V \angle -13°$$

$$S_2 = U_2 I^* = 194\,V\, e^{-j13°} \cdot 19\,A\, e^{j24} = 2328\,VA\, e^{j11°} =$$

$$= 2286\,W + j\,444\,var$$

← adatértékek rossz

$$S = U I^* = (2520 + j\,1123)\,VA$$

$$S - S_2 = S_1 = (222 + j\,685)\,VA$$

$$P_1 = |I|^2 R \qquad Q_1 = |I|^2 X_1$$