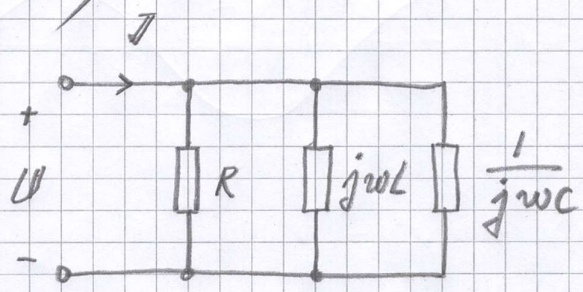
Ex 1 a)



$R = 2{,}0\ k\Omega$

$L = 1{,}0\ H$

$C = 0{,}50\ mF$

$u(t) = 1{,}0\sqrt{2}\sin(1000t + 0°)\ V$

$\rightsquigarrow \quad \mathbb{U} = 1{,}0\sqrt{2}\, e^{j0°}\ V$

$\mathbb{I} = \frac{\mathbb{U}}{\mathbb{Z}} \quad \ldots (*)$

$\frac{1}{\mathbb{Z}} = \frac{1}{R} + \frac{1}{j\omega L} + \frac{1}{1/j\omega C} =$

$= \frac{1}{R} + j\left(\omega C - \frac{1}{\omega L}\right) \Rightarrow$

$\frac{1}{\mathbb{Z}} = \frac{1}{2000} + j\left(0{,}0005 - \frac{1}{1000}\right) =$

$= 0{,}0005 - j0{,}0005 = 0{,}0005\sqrt{2}\, e^{-j45°}\ \Omega^{-1}$

INSI $(*) \Rightarrow \mathbb{I} = 1{,}0\sqrt{2}\, e^{j0°} \cdot 0{,}0005\sqrt{2}\, e^{-j45°} =$

$= 0{,}001\, e^{-j45°}\ A \rightsquigarrow i(t) = 1{,}0\sin(1000t - 45°)\ mA$

VÄXELSTRÖMSEFFEKT

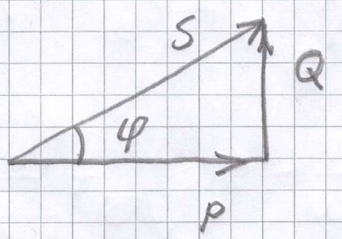
3 TYPER:

1) AKTIV EFFEKT P MÄTS I [W] OCH UTVECKLAS I RESISTORER

2) REAKTIV EFFEKT Q MÄTS I [VAr] OCH UTVECKLA I REAKTANSER (SPOLAR OCH KONDENSATORER)

3) SKENBAR EFFEKT S (P_S) MÄTS I [VA] OCH ÄR EN FORM AV SAMMANVÄGNING AV P OCH Q

$$S = \sqrt{P^2 + Q^2}$$



$$S = U \cdot I$$

OBS! EFFEKTIVVÄRDEN

$$P = S \cdot \cos\varphi$$

$\cos\varphi$ ← EFFEKTFAKTOR

$$Q = S \cdot \sin\varphi$$

Ex 1 b)

$S = U \cdot J$

$\hat{U} = 1{,}0\sqrt{2}\ V$

$U = \frac{\hat{U}}{\sqrt{2}} \Rightarrow U = 1{,}0\ V$

$\hat{J} = 1{,}0\ mA$

$J = \frac{\hat{J}}{\sqrt{2}} \Rightarrow J \approx 0{,}71\ mA$

$\Rightarrow \underline{S} = 1{,}0 \cdot 0{,}71\ mVA = \underline{0{,}71\ mVA}$

$P = S\cos\varphi$ OCH $Q = S\sin\varphi$

ÖAR $\varphi = \arg U - \arg J$

$\varphi = 0° - (-45°) = 45°$

$\Rightarrow \cos\varphi \approx 0{,}71$

$\underline{P = 0{,}50\ mW}$ OCH $\underline{Q = 0{,}50\ mVAr}$

NOTERA ATT $\underline{Z} = \frac{U}{J} \rightarrow$

$\arg Z = \arg\frac{U}{J} = \arg U - \arg J$

ALLTSÅ $\varphi = \arg Z$

ALTERNATIVT "SÄTT" ATT "RÄKNA"

$$P = \frac{U^2}{R} \rightarrow \underline{P} = \frac{1,0^2}{2000} = 50\,mW$$

$$Q = Q_L - Q_C$$

OBS! "GÄLLER KONDENSATORER"

$$Q_L = \frac{U^2}{X_L} = \frac{U^2}{\omega L} \rightarrow$$

$$Q_L = \frac{1,0^2}{1000} = 1,0\,mVAr$$

$$Q_C = \frac{U^2}{X_C} = \frac{U^2}{1/\omega C} \rightarrow$$

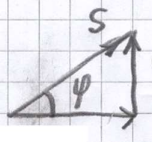
$$Q_C = \frac{1,0^2}{2000} = 0,50\,mVAr$$

$$\Rightarrow \underline{Q} = 1,0 - 0,50 = 0,50\,mVAr$$

$$S = \sqrt{P^2 + Q^2} \Rightarrow \underline{S} = 0,71\,mVA$$

$$\cos\varphi = \frac{P}{S} \rightarrow \underline{\cos\varphi \approx 0,71}$$

Ex 2 a/ $S = UJ \quad \ldots (1)$



$S = \sqrt{P^2 + Q^2} \quad \ldots (2)$

$P = P_1 + P_2 \rightarrow$

$P = 150 + 100 = 250\ W$

$Q = Q_1 + Q_2 \quad \ldots (3)$

Motor 1:

$$\tan \varphi_1 = \frac{Q_1}{P_1}$$

$\cos \varphi_1 = 0{,}80 \rightarrow \varphi_1 = 36{,}9^\circ \rightarrow \tan \varphi_1 = 0{,}75$

$$0{,}75 = \frac{Q_1}{150} \rightarrow Q_1 = 112{,}5\ VAr$$

Motor 2:

$$\tan \varphi_2 = \frac{Q_2}{P_2}$$

$\cos \varphi_2 = \frac{P_2}{S_2}$ OÄR $S_2 = UJ_2$

$S_2 = 230 \cdot 0{,}65 = 149{,}5\ VA$

$\cos \varphi_2 = \frac{100}{149{,}5} = 0{,}67 \rightarrow \tan \varphi_2 = 1{,}111$

$\rightarrow 1{,}111 = \frac{Q_2}{100} \rightarrow Q_2 = 111{,}1\ VAr$

INS i (3) $\rightarrow$ $Q = 223{,}6\ VAr$

INS i (2) →

$$S = \sqrt{250^2 + 223{,}6^2} = 335{,}4\ VA$$

INS i (1) →

$$335{,}4 = 230 \cdot J \rightarrow \underline{J = 1{,}46\ A}$$

$$\cos\varphi_{TOT} = \frac{P}{S} = \frac{250}{335{,}4} = \underline{0{,}74}$$

b) INKOPPLING AV KONDENSATOR

$$\Rightarrow Q = \underbrace{Q_1 + Q_2}_{223{,}6\ VAr} - Q_C$$

$Q = 0$ OM $Q_C = 223{,}6$ VAr

$$Q_C = \frac{U^2}{X_C} = /X_C = \frac{1}{2\pi f C}/ =$$

$$= 2\pi f C U^2 \rightarrow$$

$$223{,}6 = 2\pi \cdot 50 \cdot C \cdot 230^2 \rightarrow$$

$$\underline{C = 13{,}5\ \mu F}$$

$Q = 0 \Rightarrow S = P = 250$ VA

INS i (1) → $\underline{J = 1{,}09\ A}$ $(< 1{,}46\ A)$